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PLANETARY ATMOSPHERES

A CONTINUING BIBLIOGRAPHY
WITH INDEXES



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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PLANETARY ATMOSPHERES

A CONTINUING BIBLIOGRAPHY WITH INDEXES

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA Information System during the period June 1966–December 1967.



Scientific and Technical Information Division

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON, D.C. JULY 1968

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INTRODUCTION

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What *Planetary Atmospheres* is

This publication is the second supplement to the continuing bibliography *Planetary Atmospheres* (NASA SP-7017). It contains references to reports and journal articles announced in NASA abstract journals during the period June, 1966 through December, 1967. 357 references are included.

Previous bibliographies in this series are NASA SP-7017 (January 1962–February 1965) and NASA SP-7017(01) (March 1965–May 1966).

Scope of Bibliography

References are included for descriptions and properties of the atmospheres of Mars, Venus, Jupiter, Mercury, and Saturn. In addition, references to related subject areas, e.g., extraterrestrial environments, planetary observation techniques, and theories of planetary origin are included.

Organization of Bibliography

The bibliography is arranged in Abstracts and Index sections. The Abstracts section contains bibliographic citations and informative abstracts for the references selected from *STAR* (*Scientific and Technical Aerospace Reports*), *IAA* (*International Aerospace Abstracts*), and *Aerospace Medicine and Biology* (NASA SP-7011). The *STAR* abstracts are listed first, followed by the *IAA* and the *Aerospace Medicine and Biology* abstracts. Each set of abstracts is arranged in ascending accession number order.

The Index Section contains two indexes, subject and personal author, in that order.

How to Use this Bibliography

Reports are referenced in the *STAR* Abstracts section. Published literature items are referenced in the *IAA* Abstracts and the *Aerospace Medicine and Biology* Abstracts sections. The subject index may be used to locate references to specific topics or technical areas; the personal author index may be used to locate references to reports or articles written by a particular individual.

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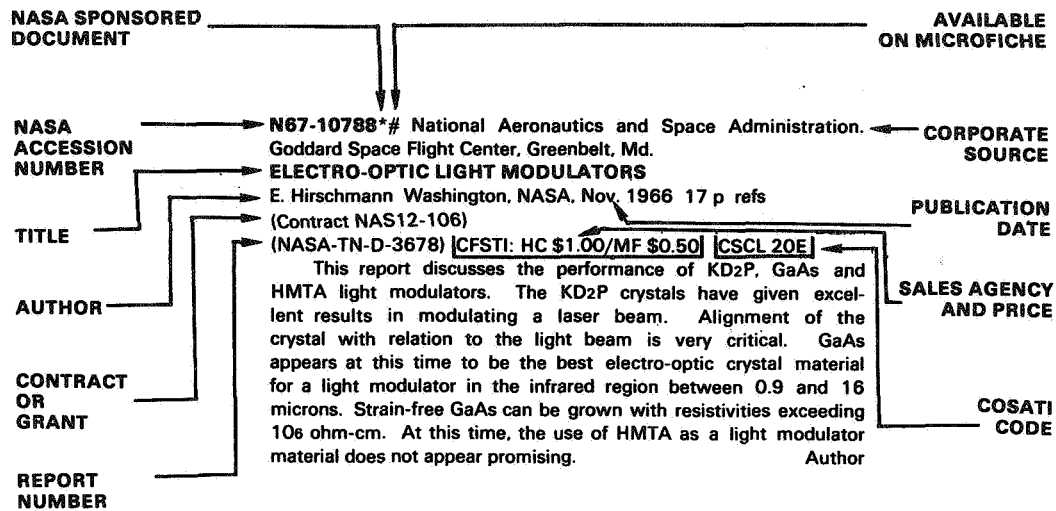
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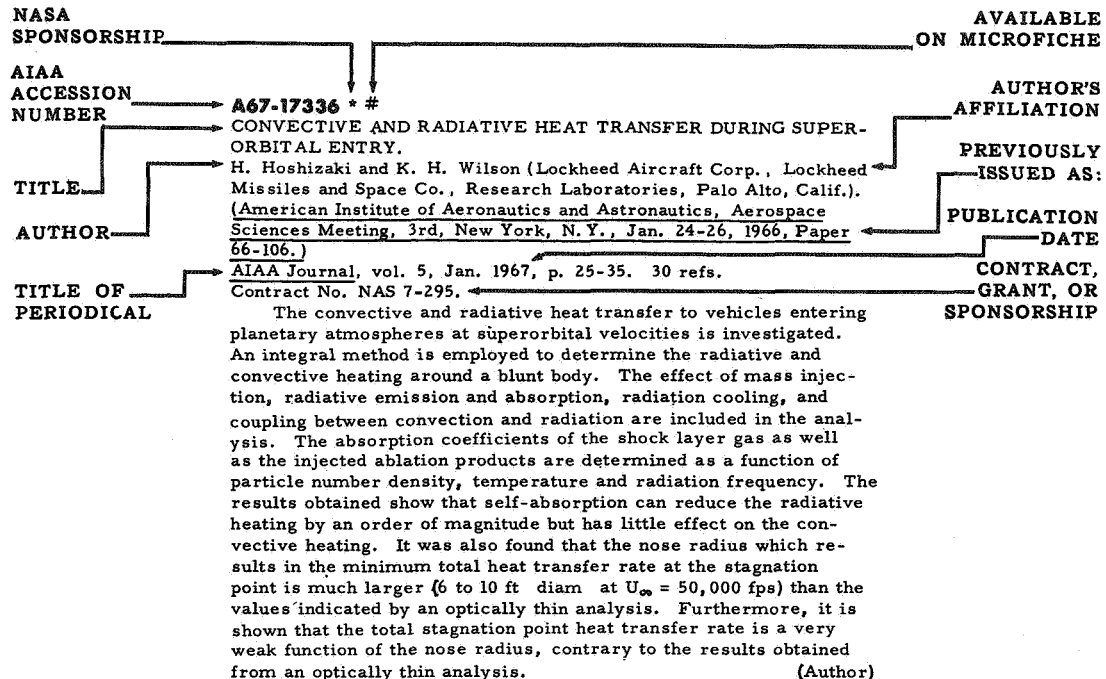
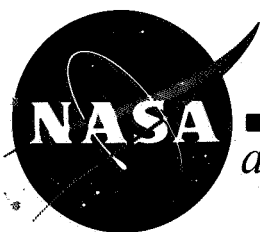


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PLANETARY ATMOSPHERES

a continuing bibliography with indexes JULY 1968

1966 STAR ABSTRACTS

N66-26263* # IIT Research Inst., Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quar-
terly Status Report, Feb. 15-May 15, 1966
Charles A. Hagen [1966] 24 p
(Contract NASr-22)
(NASA-CR-74969; IITRI-L6023-5) CFSTI: HC \$1.00/MF
\$0.50 CSCL 06F

◦ Martian environment simulation experiments to study the effects of barometric pressures, carbon dioxide concentrations, and desert soils on *Bacillus cereus* spores are reported. These included: earth atmosphere at pressures of 10-98 mb; and carbon dioxide concentrations of 37-100% at pressures of 10-98 mb. Spore germination was inhibited by carbon dioxide at all concentrations and pressures. Germination was not inhibited at 10 mb with earth atmosphere, but vegetative cell growth was less than at 98 mb. Graphs are presented showing these effects. Soil ecology experiments to determine the minimum numbers of a bacterium required to survive and grow in different soil types are described. Inhibition of *B. cereus* spore germination in pulverized felsite/limonite mixture was detected. The spores did not germinate in mixtures of pH 8-8.4, but did germinate in soil of pH 7. Low numbers of *P. aeruginosa* and *S. aureus* did not survive 7 days in a desert soil environment with 99% relative humidity at 1013 mb. N.E.N.

N66-27238* # Geophysics Corp. of America, Bedford, Mass.
THE METEOROLOGY OF MARS AND VENUS Final Report
George Ohring, Edward M. Brooks, and Joseph Mariano Mar.
1964 116 p refs
(Contract NASw-704)
(NASA-CR-75315; GCA-TR-64-4-N) CFSTI: HC \$4.00/MF
\$0.75 CSCL 03B

A thermodynamic diagram for the Martian atmosphere is constructed, based upon a model atmosphere, consisting of 83% nitrogen, 11% carbon dioxide, and 6% argon, with a surface pressure of 25 mb. A theoretical study of tides in the Martian atmosphere indicates that tidal motions play no significant role in Martian meteorology. An estimate of the annual radiation budget reveals that below latitude 35° there is a surplus of radiational energy, and above 35° there is a deficit.

Improved greenhouse models for the Venus atmosphere are developed and discussed. A two-layer greenhouse model, consisting of a troposphere with arbitrary but constant lapse-rate of temperature, and an isothermal stratosphere in gross radiative equilibrium, is applied to Venus, Mars, and Earth. For Venus, the computations indicate that the observed high surface temperatures can be the result of a strong greenhouse effect due to an infrared-opaque cloud high in the Venus atmosphere and carbon dioxide or other infrared absorbers in the atmosphere. Estimates of solar radiation absorbed by carbon dioxide in the Venus atmosphere indicate that about 12% of the solar radiation is absorbed by carbon dioxide near infrared bands. Author

N66-27755* # Georgetown Univ., Washington, D. C. Coll. Ob-
servatory.
**SPECTROSCOPIC STUDY OF SOLAR AND PLANETARY
ATMOSPHERES** Semiannual Status Report No. 6, Aug. 1,
1965-Feb. 1, 1966
Francis J. Heyden [1966] 16 p
(Grant NsG-362)
(NASA-CR-75488) CFSTI: HC \$1.00/MF \$0.50 CSCL 03B

This report describes activities performed during this period on spectroscopic studies of solar and planetary atmospheres. Spectral observations made on Venus and Jupiter are discussed. An attempt is being made to prove the existence of nitrogen oxides in the Martian atmosphere by identifying spectral lines or bands in the planet's spectrum. The main problems in positively identifying these lines and procedures to circumvent these difficulties are outlined. Infrared spectral reflectance measurements made of the Martian atmosphere are described and the results discussed. R.N.A.

N66-27957# State Univ. of Iowa, Iowa City. Dept. of Physics
and Astronomy.
**A MARINER/VENUS 1967 EXPERIMENT ON SOLAR X-RAY
ECLIPSE BY THE VENUSIAN ATMOSPHERE**
J. A. Van Allen 23 Feb. 1966 22 p refs /ts Rept.-66-4
CFSTI: HC \$1.00/MF \$0.50

A physical modification to the Mariner/Venus MC-4 space probe experimental package is proposed and described. The modification consists of remounting one of the mica-window Geiger tubes (detector A) so that it is pointed continuously at the sun. The change would make possible the continuous monitoring of soft X-rays (0-14Å) from the sun throughout the flight, including the measurement of the eclipse of solar X-rays by the Venusian atmosphere. An exemplary calculation is presented, showing that assuming a time resolution of 1 second in the data from detector A, it is possible: (1) to determine the absolute atmospheric density ρ to an accuracy of about 20% in the vicinity of $\rho = 2 \times 10^{-9}$ g/cm³ and (2) to

determine the mean scale height of the atmosphere to an accuracy better than 10% over the density range $2 \times 10^{-8} \text{g/cm}^3$. Several pertinent factors regarding the time resolution, accuracy, and the scheme of the experiment are discussed, and schematic diagrams depicting the geometry of the spacecraft trajectory, and experimental angle are also presented. A plot of calculated absorption curves is also given. L.S.

N66-28011*# Cutler-Hammer, Inc., Deer Park, N. Y.
INVESTIGATION OF NEW IONOSOUNDER TECHNIQUES
 Washington, NASA, Jun. 1966 182 p refs
 (Contract NAS5-9108)
 (NASA-CR-493) CFSTI: HC \$5.00/MF \$1.25 CSCL 03B

The objective of this report was to study the feasibility of experiments using radio sounding techniques for the investigation of the ionospheric properties of Mars and Venus. The study effort was divided into two areas. Constraints were applied in size, weight, and power consistent with modern spacecraft technology. The techniques study was concerned with instrumentation suitable for sounding a planetary ionosphere from nearby to 100,000 km from the planet in flyby or orbiting spacecraft. A parametric analysis related power, resolution, frequency, range, and other parameters of importance. A system analysis was performed using the methods of modern radar systems and applying them to ionospheric sounding. The results were applied to a specific mission, such as a Voyager flight to Mars, with requirements to sound from distances of 1000 to 40,000 km. A system to accomplish such a mission is described. Author

N66-28800*# National Biomedical Research Foundation, Silver Spring, Md.
INVESTIGATION OF THERMODYNAMIC MECHANISMS FOR THE PRODUCTION OF COMPLEX COMPOUNDS ESSENTIAL FOR THE ORIGIN OF LIFE Final Report, 1 Oct. 1965-30 Sep. 1966
 Margaret O. Dayhoff, Richard V. Eck, and Ellis R. Lippincott [1966] 127 p refs
 (Contract NSR-21-003-002)
 (NASA-CR-74559) CFSTI: HC \$4.00/MF \$1.00 CSCL 06C

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2. THERMODYNAMIC EQUILIBRIUM IN THE ORIGIN OF ORGANIC MATTER E. R. Lippincott, Y. T. Pratt (Md. Univ.), R. V. Eck, and M. O. Dayhoff 22 p refs (See N66-28802 16-06)
3. EVOLUTION OF THE STRUCTURE OF FERREDOXIN BASED ON SURVIVING RELICS OF PRIMITIVE AMINO ACID SEQUENCES R. V. Eck and M. O. Dayhoff 16 p refs (See N66-28803 16-04)
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5. PREDICTIONS OF THE COMPOSITIONS OF THE ATMOSPHERES OF THE PLANETS Richard V. Eck 1 p refs
6. THERMODYNAMIC EQUILIBRIUM ON THE PREBIOLOGICAL EARTH M. O. Dayhoff and R. V. Eck 1 p
7. PROTEIN SEQUENCES TREATED AS MATHEMATICAL PUZZLES: AN ATLAS OF PROTEIN SEQUENCE AND STRUCTURE Richard V. Eck and Margaret O. Dayhoff 1 p
8. PROGRAM RELATE M. O. Dayhoff and R. V. Eck 16 p (See N66-28804 16-04)
9. PROGRAM ALLELE R. V. Eck and M. O. Dayhoff 6 p (See N66-28805 16-04)

N66-28801*# Maryland Univ., College Park. Dept. of Chemistry.

THERMODYNAMIC EQUILIBRIA IN PLANETARY ATMOSPHERES

Ellis R. Lippincott, Richard V. Eck, Margaret O. Dayhoff (Nat. Biomed. Res. Found.), and Carl Sagan (Harvard Univ.) *In* Nat. Biomed. Res. Found. Invest. of Thermodyn. Mech. for the Production of Complex Compds. Essent. for the Origin of Life [1966] 34 p refs (See N66-28800 16-04) CFSTI: HC \$4.00/MF \$1.00

From present information on the composition, pressures, and temperatures of planetary atmospheres, we have calculated the expected thermodynamic equilibrium composition of the atmospheres of the Earth, Venus, Mars, and Jupiter. Departures from thermodynamic equilibrium must be attributed to special mechanisms, including, on the Earth, biological activity. The major constituents of the terrestrial atmosphere are found to be in approximate thermodynamic equilibrium; while many minor constituents have abundances exceeding their equilibrium values, there is a marked tendency for equilibrium to be restored. It appears that the atmosphere of Venus is in thermodynamic equilibrium, while that of Jupiter is not. The evidence for Mars is less conclusive, although not inconsistent with thermodynamic equilibrium. For none of these planets is there a molecular species with a large predicted equilibrium abundance and spectroscopically accessible absorption features which has not been already identified. The predicted equilibrium abundances of oxides of nitrogen are extremely low on all planets. Author

N66-29298*# Stanford Univ., Calif. Radioscience Lab.
THE STANFORD STUDY OF THE MARINER IV OCCULTATION DATA Semiannual Report No. 3, 1 Oct. 1965-31 Mar. 1966
 V. R. Eshleman Jun. 1966 3 p
 (Grant NGR-05-020-065)
 (NASA-CR-75816) CFSTI: HC \$1.00/MF \$0.50 CSCL 22A

The large difference in atmospheric surface pressure (actually more than 50%) between the occultation levels at Electris and Mare Acidalium is reported as the most interesting result derived from the analysis of the Mariner IV-Mars occultation experiment and the Martian atmosphere experimental models. Both the higher pressure and the smaller radius determined at Mare Acidalium suggest that this region is at a lower gravitational level than the bright Electris area. Analyzed data indicated that some of the haze and particle layers observed with earth-based telescopes and with the Mariner IV television camera may have been CO_2 particles. R.LI.

N66-29398*# National Aeronautics and Space Administration, Washington, D. C.
PLANETARY SPECTRA [SPEKTRY PLANET]
 May 1964 16 p refs Transl. into ENGLISH from Priroda (Moscow), no. 6, Jun. 1961 p 39-45
 (NASA-TT-F-888) CFSTI: HC \$1.00/MF \$0.50 CSCL 03B

The analysis of data gathered from the earth by the spectral method of investigation is discussed briefly. It is pointed out that spectroscopic investigations of the planets have developed in three principal directions: study of planetary rotation on the basis of the Doppler shift of spectra lines, photometric study of the continuous spectrum of planets as well as the search for new lines and absorption bands, and study of already known lines and bands. Reports on the results of these investigations are presented in greater detail. A survey of research on the following topics is presented: auroras, and carbon dioxide and water vapor in the Venusian atmosphere; vegetation on Mars; hydrogen and its compounds in the atmospheres

of the giant planets; the meteoric nature of Saturn's rings; luminescence and lunar surface color; and the minor planets' spectra.
R.L.I.

N66-29405* # National Aeronautics and Space Administration, Washington, D. C.

PROGRESS AND PROBLEMS IN ATMOSPHERE ENTRY

Alfred J. Eggers, Jr. and Nathaniel B. Cohen [1965] 72 p refs
Presented at the 16th IAF Intern. Congr., Athens, 13-18 Sep. 1965

(NASA-TM-X-56855) CFSTI: HC \$3.00/MF \$0.75 CSCL 22C

Problems of entry vehicle motion, heating, and heat protection are discussed in the context of current and possible future space flight missions, including unmanned probes of the atmospheres of Mars, Venus, and Jupiter, and manned vehicles appropriate for controlled planetary entry at velocities from orbital to hyperbolic. Problems in reentry physics such as transition to turbulent flow, turbulent heat transfer at hyper-velocities, and complex radiation flow-field interactions and their possible influence on vehicle configuration are discussed. Attention is also given to ground simulation facilities, such as the expansion tunnel, ballistic shock tunnel, and high enthalpy arc jet. Finally, some consideration is given to the comparative features of rocket braking and maneuvering.
Author

N66-29732* # RAND Corp., Santa Monica, Calif.

RADIATIVE-CONVECTIVE EQUILIBRIUM CALCULATIONS FOR A TWO-LAYER MARS ATMOSPHERE

C. B. Leovy May 1966 55 p refs

(Contract NASr-21(07))

(NASA-CR-75633; RM-5017-NASA) CFSTI: HC \$3.00/MF \$0.50 CSCL 03B

Preliminary to a numerical experiment in simulating the circulation of the Mars atmosphere, a computer model that simulates diurnal and seasonal variation in ground and atmospheric temperatures on Mars was constructed; it incorporates the effects of radiation, small-scale turbulent convection, and conduction into the ground. All calculations are based on an atmosphere having a surface pressure of 5 mb and composed entirely of CO₂, as indicated by the Mariner 4 occultation experiment. Adjustable parameters in the model include: the thermometric conductivity of the ground, and the rate of turbulent heat exchange between ground and atmosphere. The model is calibrated by adjusting these constants so that observations of a portion of the diurnal variation in ground temperature are well simulated. An interesting result of the calculations is the prediction of an ice cap composed of solid CO₂ whose maximum extent corresponds with that of the observed Martian polar cap. Some possible implications of the computed temperature distributions are also considered, along with space probe experiments that could be made to verify, reject, or improve the model. A simplified model was devised to compute soil heat flux that depends on surface temperature variations rather than on ground temperatures.
R.L.I.

N66-29959* # RAND Corp., Santa Monica, Calif.

A COMPUTATIONAL APPROACH TO CHANDRASEKHAR'S PLANETARY PROBLEM

R. Bellman, H. Kagiwada, R. Kalaba, and S. Veno May 1966 27 p refs

(Contract AF 49(638)-1700)

(RM-4991-PR; AD-632231) CFSTI: HC \$2.00/MF \$0.50

Chandrasekhar's planetary problem is reformulated using an initial-value approach. The problem concerns the diffuse reflection of radiation from a finite atmosphere with a reflecting surface at the bottom. In the direct problem, the angular distribution of multiple-scattered radiation is computationally obtained as the solution of an initial-value problem for ordinary differential equations for S, a generalization of the Chandrasekhar scattering function for an inhomogeneous atmosphere. In the inverse planetary problem, the properties of the atmosphere and the surface are to be estimated, given the angular distribution of scattered radiation. The quasi-linearization technique for nonlinear multipoint boundary-value problems provides an effective method for obtaining a computational solution to the inverse problem. A Fortran program for both the direct and inverse problems is presented in the appendix.
Author (TAB)

N66-30187* # TRW Systems Group, Redondo Beach, Calif.
THEORETICAL INVESTIGATION: THE SCATTERING OF LIGHT BY A PLANETARY ATMOSPHERE Final Report, 15 Sep. 1965-21 Jun. 1966

Robert S. Fraser [1966] 119 p refs

(Contract NAS5-9678)

(NASA-CR-76122; TRW-4520-6003-R000) CFSTI: HC \$4.00/MF \$0.75 CSCL 20F

Computed effects of specular reflection at the ground on the radiation scattered from a Rayleigh atmosphere are presented. The relative contribution to the ground albedo by each of several components of the radiation field is discussed. The characteristics of the neutral points in the degree of polarization that would be observed from the ground looking up or from above the atmosphere looking down are presented.
Author

N66-30788* # National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AN INITIAL CONCEPT OF A MANNED MARS EXCURSION VEHICLE FOR A TENOUS MARS ATMOSPHERE

G. R. Woodcock 7 Jun. 1966 55 p refs

(NASA-TM-X-53475) CFSTI: HC \$3.00/MF \$0.50 CSCL 22B

This report summarizes a preliminary investigation of the requirements and characteristics of a manned Mars landing vehicle to: establish how much aerodynamic braking might be feasible with thin atmosphere; determine if parachutes appear feasible and, if not, how can aerodynamic braking be phased into rocket braking for a landing; and establish a rough estimate of the total mass of a Mars landing vehicle.
Author

N66-31187* # University Coll., London (England).

AN ANALYSIS OF MARTIAN CLOUDS AND THEIR TOPOGRAPHICAL RELATIONSHIPS

R. A. Wells Paris, ESRO, May 1966 63 p refs

(ESRO-SN-54) CFSTI: HC \$3.00/MF \$0.75

The frequency of cloud occurrences distributed against heliocentric longitude is displayed in histogram form for the two chief cloud groups, white and yellow. White clouds show two peaks of maximum occurrence, while yellow clouds appear to show three peaks. Aerographic latitude plots of white and yellow cloud positions against heliocentric longitude reveal that the darkening wave is due to the transport of both water vapor and dust from high latitudes towards the equator. An examination of certain white clouds implies that at least some of the dark maria are elevations. Order of magnitude estimates of these mountain heights are calculated by a new method. The unusual 'W'-shaped cloud phenomena are explained by orographically-produced air disturbances which

imply that mountain ridges may be present on the surface with their axes arranged in the general patterns of a 'W'.

Author

N66-31351*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DYNAMIC-MODEL STUDY OF PLANETARY-ENTRY CONFIGURATIONS IN THE LANGLEY SPIN TUNNEL

Peter J. Costigan Washington, NASA, Jul. 1966 23 p refs (NASA-TN-D-3499) CFSTI: HC \$1.00/MF \$0.50 CSCL 22A

A study has been conducted in the Langley spin tunnel to determine the low subsonic speed stability and drag characteristics during vertical descent of a number of entry configurations being considered for probes of planetary atmospheres. The models tested were three of a series designated as tension shells, two blunted cones, a configuration similar to the Apollo command module, a sphere, a step-sphere, a hemisphere, and two modified spheres. The results of the study indicate that the tension shells had a limit-cycle oscillation of less than $\pm 20^\circ$ and had the highest drag coefficients of any of the configurations tested. These configurations would not return to erect positions if launched inverted, but would tumble after several increasingly large oscillations. An appendix treats the problem of scaling techniques necessary to simulate planetary environments other than that of the earth.

Author

N66-31446*# California Inst. of Tech., Pasadena.

PROCEEDINGS OF THE CALTECH-JPL LUNAR AND PLANETARY CONFERENCE

Harrison Brown, Gordon J. Stanley, Duane O. Muhleman, and Guido Muench, ed. 15 Jun. 1966 357 p refs Conf. held at Calif. Inst. of Tech., Pasadena, 13-18 Sep. 1965 Prepared jointly with JPL

(Contract NSR-05-002-050)

(NASA-CR-76142; JPL-TM-33-266) CFSTI: HC \$7.00/MF \$1.75 CSCL 03B

Conference papers on lunar and planetary studies for Mars, Jupiter, and Venus are presented. For individual titles see N66-31447-N66-31481.

N66-31463*# Johns Hopkins Univ., Baltimore, Md.

BALLOON TELESCOPE STUDIES OF VENUS

John Strong *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 147-150 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

The amount of water vapor, and the existence of ice clouds in the atmosphere of Venus were determined by telescopic and spectrometric instruments suspended from balloons over the Earth at an altitude that was above 99.9% of the Earth's water vapor and 97% of the Earth's CO_2 . Radiation was measured in the band at 1.13μ , with a grating spectrometer of 2 A resolving power once every 10 sec with a set of exit slits arrayed to match water absorption line groups. The radiation passing through was received by a chilled photomultiplier and its response was recorded on paper. A low dispersion grating, utilizing three detectors in place of the slits, was used for the ice cloud experiments. Details of the measured data are given. The influence of the doppler shift on the recorded data was also measured. The existence of water vapor and ice clouds on Venus explained the observations that the temperature of the shady side of the planet does not fall more than a few degrees short of the temperature of the sunny side as measured in the 8 to 14μ band, even though the shady side has several months to cool off. The failure to cool may be due to the

liberation of latent heat of water vapor of about 620 cal/gm, as that vapor condenses to form clouds. The results also bear on the radio emissions from Venus. L.S.

N66-31464*# RAND Corp., Santa Monica, Calif.

COMMENTS ON THE DETECTION OF WATER AND ICE CLOUDS ON VENUS

Diran Deirmendsian *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 150-154 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

The detection of water and ice clouds on Venus by Strong and his collaborators is commented upon. Comparison of terrestrial and Venusian reflected spectra lead to the tentative conclusion that the latter represent infrared sunlight diffusely reflected by a dense, unbroken Venusian ice cloud. The formation of absorption bands by scattering alone, and on cloud scattering in general are discussed with reference to water or ice particles. An experiment for detecting the glory that should be seen through an upper, optically dense, and unbroken ice cloud is proposed for verification of the Strong findings. If the visible spectrum is used, the chances would be small; but choosing a narrow region ($\lambda 1.6\mu$ or $\lambda 2.25\mu$) where neither vapor nor liquid water has significant absorption bands should increase the chances of detecting the infrared glory, particularly in regions and at times of thinning of the Venusian ice cloud. Other comments on the clouds with respect to particulate and gaseous components are also made. L.S.

N66-31465*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

PROPERTIES OF THE CLOUDS OF VENUS

Carl Sagan and James B. Pollack *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 155-163 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

A method for calculating the fraction of monochromatic radiation reflected, transmitted, and absorbed by a layer of dispersed particles having arbitrary characteristics fluxes is described; and the method is applied to an examination of the clouds of Venus. The equation of radiative transfer for monochromatic radiation nonconservatively and anisotropically scattered by a dispersed medium is given, and rewritten in an approximation form which preserves anisotropies in flux. The approximate solutions for the fluxes are compared with exact solutions for a variety of limiting and special cases, and with laboratory results; and are presented in a table. The comparisons show the approximation formulae to be accurate to 5-10% in absolute value, and a few percent in relative value. Also tabulated are comparisons of the theoretical and observed values of the albedo of Venus. Curves comparing the theoretical and observed normalized infrared reflectivities of Venus for particle radii 1-20 and $\tau_1=18$, and for particle radii 1-20 and $\tau_1=43$ are depicted (τ =interaction optical depth). The influence of the size and composition of cloud particle size on the reflection spectrum is discussed. The mutual agreement of the results supports the identification of ice as the principal constituent of the clouds of Venus. L.S.

N66-31470*# Academy of Sciences (USSR), Moscow. P. N. Lebedev Physical Inst.

SOME REMARKS CONCERNING THE RADIOASTRONOMICAL OBSERVATIONS OF VENUS

A. D. Kuzmin /*In Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf.* 15 Jun. 1966 p 184-186 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

Theoretical and experimental data curves for an aerosol model are depicted, and discussed with a view toward explaining astronomical results reported in the spectra of Venus by absorption of aerosols from the Venus atmosphere. It is shown that the radio astronomical data may be satisfied by aerosols containing polar liquid dielectric if the relaxation time of the dielectric is equal to 1.5×10^{-12} to 5×10^{-12} sec. About 0.1 to 0.2 g/cm² of such an aerosol is needed to obtain cloud heights high enough to fit the model. Substances that satisfy the data for the model can be found in literature reference books. The data are satisfied for example by some types of hydrocarbons such as CH₃OH, C₆H₅Cl, etc., and by super-cooled water. In addition, calculated curves for electron temperatures of 400°K and 300°K, together with plotted experimental results are depicted, in support of an explanation of long wavelength emissions from the Venus ionosphere. Also discussed are phase variations of the planet with respect to its brightness temperature. L.S.

N66-31471*# Paris Observatory, Meudon (France).

CONTRIBUTION TO THE CALTECH-JPL COLLOQUIUM ON THE MOON AND THE PLANETS: VENUS [CONTRIBUTION AU COLLOQUE CALTECH-JPL SUR LA LUNE ET LES PLANETES: VENUS]

Audouin Dollfus /*In Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf.* 15 Jun. 1966 p 187-202 refs In FRENCH (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

A general review is presented of data on Venus given at the lunar and planetary conference. The 1959 balloon work of Dollfus is summarized in which 70 μ of water vapor above the Venus clouds is reported, as are many photometric and polarimetric observations. The photometric data are shown to match the responses of a Venus atmosphere with a scale height of 2.8 km, a grain size of 2 μ , and a number density on the order of 3×10^8 cm⁻³. Variations in the polarization of reflected light suggest the presence of water clouds as opposed to dust clouds. In addition to the detection of water content, the study of aerosols in the upper atmosphere of Venus is discussed. Consideration is also given to atmospheric pressure in the upper layer of clouds, the polarimetric study of the nature of clouds, and deviations in the direction of polarized light. Transl. by M.W.R.

N66-31472*# California Univ., Berkeley.

THE ATMOSPHERE AND SURFACE OF MARS—A SELECTIVE REVIEW

D. G. Rea /*In Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf.* 15 Jun. 1966 p 209-238 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

A summary review of published reports pertaining to the atmosphere and surface of Mars is presented to construct a framework from which subsequent papers can be related. Some important physical properties of Mars and Earth are summarized in a table. Important properties of the Martian atmosphere, such as pressure, composition, and particulate content, as well as the presence of clouds, are discussed with accompanying data curves. The CO₂ spectral band of Mars is considered. Principal observations (polarization, spectral, brightness, microwave, and temperature studies etc.) and interpretations regarding the surface of Mars; the white areas at the poles, the bright areas; and the dark areas, are discussed. Also discussed are the TV experiment

of the Mariner IV flight; the flux of ultraviolet radiation and charged particles at the surface with respect to living organisms; and other selected observations. L.S.

N66-31473*# Kitt Peak National Observatory, Tucson, Ariz.

CO₂ BANDS AND THE MARTIAN SURFACE PRESSURE
Donald M. Hunten /*In Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf.* 15 Jun. 1966 p 240-244 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

Spectroscopic measurements of the vibration-rotation bands of CO₂ in the Martian atmosphere were made, using a 60-inch telescope in conjunction with its spectrograph, to determine the surface atmospheric pressure and composition of the atmosphere on the planet. The results suggest an atmosphere in which CO₂ is the major constituent, if not the only important one. It appears likely that the surface partial pressure of CO₂ is in the range of 4 to 7 mb, with the total pressure of about 11 to 7 mb. It seems likely that the partial pressure of other gases is not over 3 or 4 mb. This picture of a nearly pure CO₂ atmosphere is greatly strengthened by the Mariner IV results which suggest a high molecular weight and a pressure of 4 to 7 mb. The old photometric and polarimetric result of 85 mb is discredited. The discrepancy may have been due to additional scattering by aerosols in the atmosphere, or to the inherent difficulty of subtracting all the effects of light from the surface. L.S.

N66-31474*# California Univ., Berkeley.

SPECTROSCOPIC OBSERVATIONS OF MARS, 1964-5

Hyron Spinrad /*In Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf.* 15 Jun. 1966 p 245-246 (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

Doppler-shifted Martian water vapor lines were obtained with high resolution spectrograms of Mars. The amount of water vapor on Mars seems quite small, averaging about 15 μ precipitable when it is detected. The location of the Mars H₂O apparently varies with Martian season, the weak lines first appearing over the subliming North Polar Cap, and migrating south over the planet. The abundance of CO₂ in the Martian atmosphere was also redetermined, using the 5 ν_3 CO₂ band at λ 8700. The preliminary result is $\omega_{\text{CO}_2} = 80$ m-atm CO₂, which gives a CO₂ partial pressure near 6 mb. Combining this result with other recent data on the saturated CO₂ band at 1.6 μ , the total Mars surface pressure $P_s = 8_{-4}^{+6}$ mb. CO₂ is therefore the major constituent. A portion of the Mars spectrum at the 5 ν_3 CO₂ band is depicted. Positions of the weak rotational lines of CO₂ in the R and P branches are indicated. The clearly visible R12, 10, and 8 lines are noted. L.S.

N66-31475*# IIT Research Inst., Chicago, Ill.

RECENT OBSERVATIONS OF THE PHOTOGRAPHIC SPECTRUM OF MARS—A PRELIMINARY REPORT

Tobias Owen /*In Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf.* 15 Jun. 1966 p 247-251 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

The CO₂ abundance in the Martian atmosphere was re-determined spectroscopically by means of observations in the weak bands of 8689 Å and 1.05 μ . One plate of the 8689 Å band which recorded measurable absorptions for lines in the P and R branches is reproduced. The means of reducing the data, which included determining the mean atmospheric temperature, correction of line intensities, and determination of air mass are described; and the result obtained for the CO₂ abundance from the foregoing parameters is given. The derived value of CO₂ abundance was 67 ± 20 m-atm. The corre-

sponding surface pressure was calculated by two independent methods, (method of Moroz, and method of Owen and Kuiper) and lies between 8 and 9 mb with a lower limit of 5 mb and an upper limit of 20 mb. The low surface pressure and high CO₂ content suggests that the present atmosphere of Mars may be similar in composition to the primitive outgassed atmosphere of the earth, with the exception of the low Martian abundance of water. This implies that Mars may never have had a more massive atmosphere than it possesses at the present time. L.S.

N66-31477*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PRELIMINARY RESULTS OF THE MARINER IV OCCULTATION MEASUREMENT OF THE ATMOSPHERE OF MARS

A. J. Kliore, D. L. Cain, G. S. Levy, V. R. Eshleman, G. Fjeldbo (Stanford Univ.) et al. *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 257-266 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

(Contract NAS7-100; Grants NGR-05-020-65; NsG-377)

This paper reviews the preliminary results of the radio occultation measurement of the Martian atmosphere conducted as the Mariner IV spacecraft passed behind the planet. Results of the data analysis showed that values of density, pressure, scale height, and temperature near the Martian surface were lower than expected. Based on the occultation results and terrestrial spectroscopic measurements of CO₂ abundance in the atmosphere of Mars, it is concluded that CO₂ must be the primary atmospheric constituent. R.N.A.

N66-31478*# Stanford Univ., Calif.

PRELIMINARY RESULTS OF THE MARINER IV RADIO OCCULTATION MEASUREMENTS OF THE UPPER ATMOSPHERE OF MARS

G. Fjeldbo, V. R. Eshleman, A. J. Kliore, D. L. Cain (JPL), F. D. Drake (Cornell Univ.) et al. *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 267-272 refs (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

(Contract NAS7-100; Grants NGR-05-020-065; NsG-377)

This paper discusses that part of the radio occultation measurement of the Martian atmosphere, conducted as the Mariner IV spacecraft passed behind the planet, that is related to the upper atmosphere of Mars. An attempt is made to show how the Martian atmosphere changes with altitude, i.e., the temperature profile, number density profiles, etc., together with the controlling physical and chemical processes. A summary of the more striking features of the upper atmosphere of Mars is tabulated. R.N.A.

N66-31481*# Paris Observatory, Meudon (France).

CONTRIBUTION TO THE CALTECH-JPL COLLOQUIUM ON THE MOON AND THE PLANETS: MARS [CONTRIBUTION AU COLLOQUE CALTECH-JPL SUR LA LUNE ET LES PLANETES: MARS]

Audouin Dollfus *In* Calif. Inst. of Tech. Proc. of the Caltech-JPL Lunar and Planetary Conf. 15 Jun. 1966 p 289-305 refs *In* FRENCH (See N66-31446 18-30) CFSTI: HC \$7.00/MF \$1.75

Attention is given to the measurement of water in the atmosphere of Mars and the photometric properties of the Martian soil in a review of contributions of the conference. It is noted that water vapor is not always detectable in the

spectrum of Mars, but that it sometimes appears on certain locations of the planet. Absolute values obtained for the luminosity of the light and dark sides of Mars are discussed, and variations in diffusion are graphed as a function of phase angle and distance from the center of the core. Diffusion of the Martian atmosphere can be determined by measuring the polarization of light, and curves are plotted for the visual and photoelectric spectra from 0.50 to 1.05 μ . Residual pollution in the Martian atmosphere and spectroscopic findings by Mariner IV are mentioned. It is noted that the dark spots of the Martian soil almost completely disappear in the blue spectrum, and transparency of the atmosphere in this region is discussed. Transl. by M.W.R.

N66-31488*# Johns Hopkins Univ., Baltimore, Md.

BALLOON-TELESCOPE OBSERVATION OF THE PLANETS

John D. Strong *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 8 p refs

CFSTI: HC \$7.00/MF \$1.75

The determination of water vapor in the upper atmosphere of Venus by an automatic telescope-spectrometer unit aboard a balloon at an altitude of 27 km is discussed. Various aspects of the data recording system, data reduction, and results are presented. The 21 positions of the exit slits used are given, a single slit scan across the water band is graphed, and a double scan showing absorption by water vapor is pictured. The reflection spectrum of Venus clouds is graphed to show correction for the upper atmosphere of Venus, and the terrestrial water above 26.5 km is illustrated. It is concluded that, within limits set by the uncertainties of the agreement, the effective cloud reflections determined for radiations of 1.1, 1.9, and 2.6 microns all lie at essentially the same altitude. It is noted that the Venus cloud surface temperature is about -40°C, and does not vary significantly from light to dark side. The latent heats and freezing of water provide the mechanism for sustaining this temperature on the dark side. M.W.R.

N66-31489*# RAND Corp., Santa Monica, Calif.

SOME ASPECTS OF THE CIRCULATION OF MARS

Conway Leary *In* VPI Proc. of the Conf. on the Exploration of Mars and Venus Aug. 1965 10 p refs

CFSTI: HC \$7.00/MF \$1.75

Vertical temperature distribution, diurnal heating and tides, and differential heating and general circulation at the solstices are discussed in connection with the circulation of the Martian atmosphere. A schematic diagram of solstice circulation on Mars indicates that the winter hemisphere contains strong zonal west winds that increase with height, except for a shallow belt of easterlies near the ground in low latitudes. The summer hemisphere is dominated by easterlies increasing with height, except for a relatively shallow belt of surface westerlies. The meridonal circulation associated with the eddy regime has descending motion toward the equator of the west wind maximum and ascending motion poleward of the maximum; and such circulation results from the zonal momentum produced by the eddies. Various circulation estimates are given and observations are graphed. M.W.R.

N66-31491*# National Aeronautics and Space Administration, Washington, D. C.

THE SYSTEMATIC INVESTIGATION OF THE METEOROLOGY OF MARS

Morris Tepper *In VPI Proc. of the Conf. on the Exploration of Mars and Venus* Aug. 1965 14 p ref
CFSTI: HC \$7.00/MF \$1.75

Weather observation and prediction for the manned Mars landing program is discussed. Four approaches used in forecasting are briefly summarized: analogue, statistical, empirical, and numerical. The dynamical or numerical approach is chosen as the most applicable to Mars. The acquisition of atmospheric data globally on Mars is described as analogous to observations on Earth. A solution to the problem of obtaining data lies in the use of Earth orbiting satellites. The satellite is discussed as an instrument platform and as a data collection and relay device. S.P.

N66-31639* # Smithsonian Astrophysical Observatory, Cambridge, Mass.

SELECTED STUDIES IN EXOBIOLGY, PLANETARY ENVIRONMENTS, AND PROBLEMS RELATED TO THE ORIGIN OF LIFE Semiannual Progress Report No. 1, 1 Oct. 1965-31 Mar. 1966

Carl Sagan Jun. 1966 130 p refs

(Grant NGR-09-015-023)

(NASA-CR-76106) CFSTI: HC \$4.00/MF \$1.00 CSCL 06F

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2. PROPERTIES OF THE CLOUDS OF VENUS C. Sagan and J. B. Pollack 16 p refs (See N66-31641 18-30)

3. THERMODYNAMIC EQUILIBRIA IN PLANETARY ATMOSPHERES E. R. Lippincott (Md. Univ.), R. V. Eck, M. O. Dayhoff (Natl. Biomed. Res. Found.), and C. Sagan 37 p refs (See N66-31642 18-30)

N66-31640* # Smithsonian Astrophysical Observatory, Cambridge, Mass.

AN ANALYSIS OF THE MARINER 2 MICROWAVE OBSERVATIONS OF VENUS

James B. Pollack and Carl Sagan *In its Selected Studies in Exobiol., Planetary Environments, and Probl. Related to the Origin of Life* Jun. 1966 69 p refs (See N66-31639 18-04)
CFSTI: HC \$4.00/MF \$1.00

Limb-darkening observations of Venus by 19 mm microwave channel onboard Mariner 2 spacecraft were analyzed and compared with ground-based measurements in a hot-surface context. Peak brightness temperatures near the center of each scan, temperatures of the emitting level, and total optical depths of the microwave attenuators were related to the five following capacity models: (1) transition of CO₂ and N₂ throughout the atmosphere; (2) water vapor absorption; (3) aerosol of absorbing dust; (4) isothermal absorbing cloud layer; and (5) an aerosol of scattering particles, arbitrarily distributed with altitude. Results rendered the CO₂-N₂, the water vapor, and the absorbing dust models untenable and suggested that the observed radiation arises from a hot surface and atmosphere. G.G.

N66-31641* # Smithsonian Astrophysical Observatory, Cambridge, Mass.

PROPERTIES OF THE CLOUDS OF VENUS

Carl Sagan and James B. Pollack *In its Selected Studies in Exobiol., Planetary Environments, and Probl. Related to the Origin of Life*, Jun. 1966 16 p refs (See N66-31639 18-04)
CFSTI: HC \$4.00/MF \$1.00

We have obtained in the Schuster-Schwarzschild approximation theoretical formulae describing the monochromatic transmissivity, reflectivity, and absorptivity of a cloud layer characterized by an arbitrary single scattering albedo and anisotropic phase function. The application of this formalism combined with exact solutions to the Mie theory problem to the observed visual and near infrared reflectivity of Venus permits the determination of a number of properties of the Cytherean cloud layer. We confirm Strong's identification of ice as the principal constituent of the clouds. In addition the mean radius of cloud particles lies between 7.5 μ and 10 μ , while the interaction optical depth of the layer is between 18 and 43. Clouds with these properties allow a sizeable fraction of the incident sunlight to penetrate to the surface, but are extremely opaque to radiation thermally produced by the planet. A greenhouse mechanism therefore appears to be operative which can explain the high surface temperature of Venus. Author

N66-31642* # Smithsonian Astrophysical Observatory, Cambridge, Mass.

THERMODYNAMIC EQUILIBRIA IN PLANETARY ATMOSPHERES

Ellis R. Lippincott (Maryland Univ.), Richard V. Eck (Natl. Biomed. Res. Found.), Margaret O. Dayhoff, and Carl Sagan *In its Selected Studies in Exobiol., Planetary Environments, and Probl. Related to the Origin of Life* Jun. 1966 37 p refs (See N66-31639 18-04) CFSTI: HC \$4.00/MF \$1.00

The thermodynamic equilibrium composition of all possible combinations of the elements C, H, O, and N at reasonable average pressures and temperatures have been calculated for the atmospheres of Earth, Venus, Mars, and Jupiter. All regions of the composition diagram consistent with the observed molecular abundances are located and discussed. The atmosphere of Venus seems likely to be in thermodynamic equilibrium. It then follows that the measured upper limits on the abundances of CH₄, NH₃, and CO are all inconsistent with the possibility of elemental carbon or hydrocarbons in contact with the atmosphere, either on the surface or as clouds. Venus must have begun its evolutionary history with a [C/O] abundance ratio ≤ 0.5 , a value consistent with several cosmic abundance estimates. The evidence for Mars is not inconsistent with thermodynamic equilibrium. Equilibrium abundances of all oxides of nitrogen are extremely low even if computed with a considerable excess of O₂. Under equilibrium conditions at low temperatures Jupiter also cannot contain significant amounts of any molecule not yet observed. However, at high temperatures simple hydrocarbons and cyanides, polycyclic aromatics, and a variety of nitrogen compounds would be expected. Some of these compounds are brightly colored and possibly contribute to the observed variable coloration of Jupiter. Author

N66-31819* # AVCO Corp., Lowell, Mass. Space Systems Div.

COMPARATIVE STUDIES OF CONCEPTUAL DESIGN AND QUALIFICATION PROCEDURES FOR A MARS PROBE/LANDER. VOLUME III: PROBE, ENTRY FROM ORBIT. BOOK 1: SYSTEM DESIGN Final Report

T. R. Ellis et al 11 May 1966 302 p

(Contract NAS1-5224)

(NASA-CR-66131; AVSSD-0006-66-RR, V. III, Bk-1) CFSTI: HC \$4.25/MF \$1.75 CSCL 22B

The system design of a non survivable probe to perform engineering experiments for the determination of Mars atmospheric and terrain properties is presented. The flight capsule is to be deployed from the flight spacecraft while in Mars orbit to allow use of shallow entry angles required by model

atmospheres which vary from 5- to 10- millibars surface pressures. The study includes all necessary parametric and systems analyses leading to a conceptual design, with particular emphasis on critical tradeoff regions and the necessary assumptions and decisions which have led to the conceptual design. Experiment designs for television, surface hardness penetrometers, and wind measurement instrumentation which is included in the science payload are discussed. Mission constraints, subsystem characteristics, entry vehicle design, deorbit techniques, attitude control system tradeoffs, and capsule telecommunications are also reported. A.O.

N66-31926*# Minnesota Univ., Minneapolis. School of Physics.

A STUDY OF THE FEASIBILITY OF EMPLOYING A MAGNETIC MASS SPECTROMETER FOR THE ANALYSIS OF THE MARTIAN ATMOSPHERE

Alfred O. C. Nier 20 Dec. 1962 58 p refs Prepared for JPL (Contracts NAS7-100; JPL-950241)

(NASA-CR-76498) CFSTI: HC \$2.50/MF \$0.50 CSCL 03A

A study of magnetic-sector mass spectrometers has been conducted to test the feasibility of employing such instruments for making analyses of planetary atmospheres. A number of designs of spectrometers were tried, as were appropriate transistorized electronic circuits. A preliminary study of a miniature sputter ion pump was also carried out. The investigations showed that essentially all but the weight specification given in SW-2751 could be met. It is likely that further studies will result in weight reductions. This would certainly be the case if a reconsideration of the entire problem showed that some of the other specifications could be modified. Author

N66-31944*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE ATMOSPHERE OF MARS: A DERIVATION OF ENGINEERING AND DESIGN PARAMETERS

W. T. Roberts and George S. West 29 Jun. 1966 38 p refs (NASA-TM-X-53484) CFSTI: HC \$2.00/MF \$0.50 CSCL 03B

Three model atmospheres have been derived for use in mission planning, aerospace lander design, and Martian orbiter and flyby studies. Atmospheric parameters for these three models have been calculated from the planetary surface to 10,000 kilometers. These three model atmospheres of differing atmospheric composition, surface pressure, and surface temperature are the upper density model (60 percent CO₂ and 40 percent N₂); the mean density model (100 percent CO₂); and the lower density model (80 percent CO₂ and 20 percent Ar). The general program of Kern and Schilling, with a few revisions, was used; this publication contains the details of the mathematical basis and program routines in considerable depth. The models chosen should provide values which will be of use as guidelines for the engineering and design of orbiting and landing vehicles. Author

N66-32006*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PUBLICATIONS OF GODDARD SPACE FLIGHT CENTER, 1963. VOLUME I: SPACE SCIENCES

[1963] 1556 p refs

(NASA-TM-X-57737) GPO: HC \$9.75; CFSTI: MF \$7.50 CSCL 03B

A collection of articles, papers, talks, and reports on astronomy and astrophysics, celestial mechanics and geodesy, solar physics, ionosphere and radio physics, fields and par-

ticles, planetology, planetary atmospheres and general topics are presented. For individual titles see N66-32007-N66-32043.

N66-32034*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE ORIGIN OF THE ATMOSPHERES OF VENUS AND THE EARTH

A. G. W. Cameron *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1337-1345 refs (See N66-32006 18-30) GPO: HC \$9.75; CFSTI: MF \$7.50

Evidence regarding the Earth's atmosphere is reviewed and it is concluded that there are no detectable traces of the primitive solar nebula surviving in it. Evidence concerning the Venus atmosphere is analyzed and it is concluded that it probably contains of the order of 100 times the amount of nitrogen in the Earth's atmosphere and negligible amounts of water vapor. It is very difficult to see how the two atmospheres can have had a common origin, and it is proposed that the bulk of the Venus atmosphere is a remnant of the primitive solar nebula. In order to account for the absence of primitive gases from the Earth's atmosphere, a modified form of the Darwin-Wise hypothesis is proposed, according to which the Moon is formed as a result of the Earth's rotational instability induced for formation of the iron core. During such rotational instability the primitive gases would be entirely lost. A discussion is given of the circumstances surrounding the period of rotational instability. Author

N66-32039*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STRUCTURE OF PLANETARY ATMOSPHERES

S. I. Rasool *In its* Publ. of Goddard Space Flight Center, 1963, Vol. I [1963] p 1464-1485 refs (See N66-32006 18-30) GPO: HC \$9.75; CFSTI: MF \$7.50

The properties of the atmospheres of Mars, Venus, and Jupiter are reviewed in the light of the observational results stemming from intensified research activity in the field of planetary atmospheres. Temperature is the most significant parameter in studying planetary atmospheres, and as an aid to the discussion, the temperature structure of the Earth's atmosphere is examined. In order to fit the observed data, new model atmospheres for the planets considered were derived. The discussion of these models includes, atmospheric composition and pressure, vertical distribution of temperature, upper atmosphere and ionosphere, and radiation belts. H.S.W.

N66-32064*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ATMOSPHERIC SAMPLING INSTRUMENTATION

Nelson W. Spencer *In its* Publ. of Goddard Space Flight Center, 1963, Vol. II [1963] p 583-586

CFSTI: HC \$7.00/MF \$5.00

The use of a capsule as instrument carrier for Martian atmospheric measurements is advocated as a reliable and safe exploration device. The capsule will enter the planetary atmosphere by parachute and deploy its antennas and sensors during descent to the surface. Its sensors will obtain the following measurements: (1) atmospheric temperature and pressure data from thermistors and potentiometer gauges; (2) mean molecular mass and air density from acoustic devices; and (3) the total amounts of CO₂, H₂O, and O₃ for the area between the sensor and the sun by infrared absorption

detector. The obtained information can then be utilized to determine the temperature, pressure, density, and gross composition profiles of the Martian atmosphere. G.G.

N66-32302* # Southwest Center for Advanced Studies, Dallas, Tex.

THE ATMOSPHERE OF MARS

Francis S. Johnson [1966] 16 p refs Presented at the COSPAR 7th Intern. Space Sci. Symp., Vienna, 10-19 May 1966

(Grant NsG-269)

(NASA-CR-76666) CFSTI: HC \$1.00/MF \$0.50 CSCL 03B

Much new information has become available in recent years on the Martian atmosphere. Mariner IV data have shown that the surface pressure is below ten millibars, a result that is not inconsistent with the most recent spectroscopic studies. If the Mariner IV ionospheric data are interpreted in terms of an F2 peak, the atmosphere must be very cold at all levels and the exospheric temperature must be near 85°K. This result is in disagreement with studies of radiative equilibrium temperatures, which indicate a relatively warm exosphere, the temperature being in the vicinity of 400°K. As a consequence of this inconsistency and others of a similar nature, there is still a wide range of speculation concerning the properties of the Martian atmosphere. These inconsistencies will probably be resolved only after more detailed observations have been made in planetary probes, such as the distribution of resonance scattering of sunlight by atomic oxygen. Author

N66-33271 # Army Electronic Proving Ground, Fort Huachuca, Ariz. Research Div.

NUMERICAL SOLUTION OF THE TRANSPORT AND ENERGY EQUATIONS IN THE PLANETARY BOUNDARY LAYER

William D. Ohmstede Apr. 1966 156 p refs

(ECOM-6020; AD-633694) CFSTI: HC \$5.00/MF \$1.00

This report presents the development of an algorithm for the approximate prediction of the physical behavior of the planetary boundary layer. For the sake of brevity, the problem is restricted to one which displays most of the essential features involved. By means of various approximations, the problem is stated in mathematical terms. The behavior of the planetary boundary layer is described by a system of nonlinear partial differential equations of the parabolic type, and boundary conditions at the earth's surface are developed in terms of the energy balance principle, through a priori analysis. It is inferred that the problem is well-posed. Various finite-difference operators are proposed and shown to be consistent with the differential operators. The boundedness and computational stability of the solutions of the finite-difference operators are discussed. It is concluded that the pure implicit nonlinear operator is the most satisfactory for the development of the algorithm. The algorithm is developed in detail and several solutions are presented to illustrate the results obtainable from it. Author (TAB)

N66-33414* # California Univ., Berkeley. Space Sciences Lab. THE BLUE HAZE OF MARS

Ann Palm 7 Dec. 1964 25 p refs Submitted for Publication Its Ser. No. 5, Issue No. 70

(Grant NsG 243-62)

(NASA-CR-59938) CFSTI: HC \$1.00/MF \$0.50 CSCL 03B

The extent of blue clearings is investigated as a function of the number of the meteor showers intersecting Mars' orbit, at 10° intervals of heliocentric longitude. A rank correla-

tion method has been employed. The analysis indicates a small but statistically significant negative correlation between the extent of blue clearing and meteor shower activity. This result combined with the optical properties of the Martian atmosphere and the close resemblance between the characteristics of the blue haze and those of the terrestrial noctilucent clouds suggests that variable amounts of interplanetary dust are suspended in the Martian atmosphere and that the occasional clearings of the blue haze are caused by a diminishing influx of these dust particles. Author

N66-33437* # New York Univ., N. Y. Dept. of Meteorology and Oceanography.

PROJECT HIAM Informal Report, Dec. 1965-May 1966

Wayne E. Mc Govern [1966] 21 p refs

(Grant NsG-499)

(NASA-CR-77048) CFSTI: HC \$1.00/MF \$0.50 CSCL 01B

Progress is reported on a number of astrophysical and geophysical studies. They include the atmosphere of Mercury, the atmosphere of Mars, the ashen light emission from the dark side of Venus, the 26-month oscillation of ozone concentration, calculation of average single particle scattering functions for clouds and aerosols, calculation of the distribution of scattered radiation in a plane parallel atmosphere, heat budget of the earth, the earth's albedo, degradation of the Tiros VII radiometers, optical constants of ammonium sulfate and sulfuric acids, and atmospheric breaking waves. R.N.A.

N66-33526* # Israel Program for Scientific Translations, Ltd., Jerusalem.

PHYSICS OF THE MOON AND THE PLANETS

I. K. Koval', ed. 1966 116 p refs Transl. into ENGLISH of "Fizika Luny i Planet" Kiev, Naukova Dumka, 1964 Prepared for NASA and NSF

(NASA-TT-F-382; TT-66-51019) CFSTI: HC \$4.00/MF \$1.00 CSCL 03B

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1. POLYCHROMATIC POLARIMETRY OF SOME LUNAR REGIONS V. V. Avramchuk p 1-10 refs (See N66-33527 19-30)
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3. SPECTRAL STUDIES OF THE LUNAR SURFACE A. N. Sergeeva p 23-33 refs (See N66-33529 19-30)
4. ON THE STUDY OF THE OPTICAL PROPERTIES OF THE ATMOSPHERE AND SURFACE OF MARS I. K. Koval' p 34-39 refs (See N66-33530 19-30)
5. THE BRIGHTNESS DISTRIBUTION IN THE MARGINAL ZONE OF MARS L. A. Bugaenko, O. I. Bugaenko, I. K. Koval', and A. V. Morozhenko p 40-42 refs (See N66-33531 19-30)
6. RESULTS OF POLARIMETRIC OBSERVATIONS OF MARS IN 1962-1963 A. V. Morozhenko p 43-60 refs (See N66-33532 19-30)
7. DETERMINATION OF OPTICAL PARAMETERS OF THE ATMOSPHERE AND SURFACE OF MARS A. V. Morozhenko and E. G. Yanovitskii p 61-68 refs (See N66-33533 19-30)
8. APPROXIMATE SOLUTION OF THE PROBLEM OF DIFFUSE REFLECTION AND TRANSMISSION OF LIGHT IN PLANETARY ATMOSPHERES WITH AN ARBITRARY SCATTERING INDICATRIX E. G. Yanovitskii p 69-82 refs (See N66-33534 19-30)

9. DIRECT-READING RECORDING ELECTROPOLARIMETER OF THE MAIN ASTRONOMICAL OBSERVATORY OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR O. I. Bugaenko p 83-93 refs (See N66-33535 19-30)
10. TYPES OF COMETARY TAILS A. A. Demenko p 94-103 refs (See N66-33536 19-30)

N66-33530*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE STUDY OF THE OPTICAL PROPERTIES OF THE ATMOSPHERE AND SURFACE OF MARS

I. K. Koval' *In its Phys. of the Moon and the Planets* 1966 p 34-39 refs (See N66-33526 19-30) CFSTI: HC \$4.00/MF \$1.00

Following a review of various findings dealing with the surface of the moon, it is concluded that the distribution of energy in the visible spectrum of Mars and its color depend mainly on surface energy distribution. The surface of Mars may be regarded as covered by a powdered limonite which is orange in color; and the visual albedo of Mars and the albedo of the true surface may differ slightly from each other. During clear periods, fluctuations of the visual albedo in the violet region may not be noticed. The true continent-mare contrast at $\lambda = 400 \text{ m}\mu$ is usually entirely blurred by an atmospheric veil produced by light scattering in the Martian atmosphere. In the 400 to 650 $\text{m}\mu$ range, the light is scattered in the same sense as Rayleigh scattering, so that toward lower wavelengths the rate of limb darkening of the apparent disk is more gradual. At even greater wavelengths, coarse particles float in the Martian atmosphere and result in a decrease in the limb darkening to the infrared.

M.W.R.

N66-33533*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF OPTICAL PARAMETERS OF THE ATMOSPHERE AND SURFACE OF MARS

A. V. Morozhenko and E. G. Yanovitskii *In its Phys. of the Moon and the Planets* 1966 p 61-68 refs (See N66-33526 19-30) CFSTI: HC \$4.00/MF \$1.00

The known brightness distribution of the Martian disk was used to determine the optical parameters of its atmosphere and surface from absolute photometric data. A computational procedure and related tables are given which enable the calculation of these optical parameters with relative ease and accuracy. It is assumed that the Martian highlands are orthotropically reflecting, that these parameters are constant for all scanned points of the highland from which the brightness distribution curve is plotted, and that the atmosphere of Mars does not absorb selectively in the entire range of wavelengths used in Martian photometry. In the 450 to 850 $\text{m}\mu$ range, the Martian atmosphere is purely scattering; below this true absorption is felt which increases with decreasing wavelength. During dust storms, the optical thickness of the Martian atmosphere in the infrared decreases with increasing wavelength because of the presence of coarse dust particles.

M.W.R.

N66-33534*# Israel Program for Scientific Translations, Ltd., Jerusalem.

APPROXIMATE SOLUTION OF THE PROBLEM OF DIFFUSE REFLECTION AND TRANSMISSION OF LIGHT IN PLANETARY ATMOSPHERES WITH AN ARBITRARY SCATTERING INDICATRIX

E. G. Yanovitskii *In its Phys. of the Moon and the Planets* 1966 p 69-82 refs (See N66-33526 19-30) CFSTI: HC \$4.00/MF \$1.00

Approximate methods are considered for the solution of the equation of radiative transfer in planetary atmospheres, and formulas for brightness factors are derived by a method based on certain Chandrasekhar relations. Both a medium of infinite optical thickness and an atmosphere of finite optical thickness and an atmosphere of finite optical thickness are treated, with appropriate formulas evolved for each case. The accuracy of the formulas was estimated for a plane layer of finite optical thickness, and the resultant graphs indicate that the error in the calculations does not exceed 10% for the simplest nonspherical indicatrix. It is concluded that, in the majority of cases, this estimate applies also to brightness factors of the diffusely reflected and diffusely transmitted radiation.

M.W.R.

N66-34373*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

DIRECT CALCULATION OF SPECIFIC HEATS AND RELATED THERMODYNAMIC PROPERTIES OF ARBITRARY GAS MIXTURES WITH TABULATED RESULTS

Perry A. Newman and Dennis O. Allison Washington, NASA, Aug. 1966 57 p refs

(NASA-TN-D-3540) CFSTI: HC \$2.50/MF \$0.50 CSCL 20M

It is shown that the partial derivatives of the species concentrations can be computed using the same matrix of coefficients as that used in the free-energy minimization iterations to determine the equilibrium concentrations. The second-order thermodynamic properties directly computed from these derivatives agree very well with existing properties (both directly and numerically obtained) for air considered as a mixture of ideal gases. Comparison of these results with recent imperfect air results shows that the "mixture of ideal gases approximation" produces acceptable engineering data (error less than 5 percent) for temperatures $\leq 15,000^\circ \text{K}$ and pressures $\leq 10^2$ atmospheres. Tabulated results for the high-temperature thermodynamic properties of NASA engineering model Mars atmosphere 3 are given for 36 pressures at each of 56 temperatures.

Author

N66-34667*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

CONTINUATION OF STUDIES IN STATISTICAL DECISION THEORY IN LARGE SCALE BIOLOGICAL EXPERIMENTS Final Report, 1 May 1965-31 Jul. 1966

Dian R. Hitchcock and Gordon B. Thomas 31 Jul. 1966 65 p refs

(Contract NASw-871)

(NASA-CR-77234; SLS-6309R) CFSTI: HC \$3.00/MF \$0.75 CSCL 06C

The empirical implications of the viewpoint that living organisms are characterized by some feature equivalent to or implied by the negative entropy assumption is examined. The biological significance of atmospheric compositions and surface atmosphere reactions were studied, with emphasis placed on demonstrating the validity of a characterization of life in terms of its ability to establish and maintain a free energy gradient between itself and some portion of its environment. The Martian analysis atmosphere is analyzed, and the extrapolation of these results to a life detection experiment is considered. The distribution of n-alkanes in materials of biotic, abiotic, and unknown origin was observed to determine whether the order in these distributions could be computed from a digitized gas chromatogram. A class of processes was selected which are described in terms of the information which some subset of the ordinates of the observed chromatogram conveys about the whole chromatogram. Comparative data on the various materials are presented.

M.G.J.

N66-34876# RAND Corp., Santa Monica, Calif.
REDUCTION OF THE EQUATIONS OF RADIATIVE TRANSFER FOR A PLANE-PARALLEL, PLANETARY ATMOSPHERE, PART I

Zdenek Sekera Jun. 1966 84 p refs
 (Contract AF 49(638)-1700; Proj. RAND)
 (RM-4951-PR, Pt. I; AD-635284)

A discussion is presented of the reduction of the equations of radiative transfer when the phase matrix is separable. A separable matrix is one that can be expressed as the product of two matrices, one whose elements depend on the directional parameters of the incident beam alone, and the other whose elements depend on the directional parameters of the scattered beam alone. When the phase matrix can be developed as a harmonic series in the azimuth difference between the vertical planes containing the scattered and incident beams and each term of this series is separable. The radiative transfer equations have series solutions with each term in these series being given by a product of three matrices; one of these is azimuth-independent; the other two, which post- and pre-multiply this matrix, are the same matrices whose product forms the corresponding term in the phase matrix. Author (TAB)

N66-35309*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONDITIONS OF ENCOUNTER BETWEEN DUST AND THE PLANETERS

Curtis W. McCracken [1965] 30 p refs Submitted for Publication
 (NASA-TM-X-57009) CFSTI: HC \$2.00/MF \$0.50 CSCL 03B

The conditions of encounter between interplanetary dust particles and the planets are investigated for the range of particle size where the force of solar radiation is not negligible in comparison with the force of solar gravity. The action of solar radiation pressure in reducing the heliocentric orbital speed of a small dust particle makes possible very low planetocentric speeds at encounter for an entire class of heliocentric orbits of non-zero eccentricity and fairly low inclination. The speed at encounter and the apparent radiant depend on the size of the dust particle for a given heliocentric orbit throughout the range of particle size being investigated by means of dust particle sensors mounted on spacecraft. Author

N66-35579# RAND Corp., Santa Monica, Calif.
REDUCTION OF THE EQUATIONS OF RADIATIVE TRANSFER FOR A PLANE-PARALLEL, PLANETARY ATMOSPHERE, PART II

Zdenek Sekera Jul. 1966 69 p refs
 (Contract AF 49(638)-1700; Proj. RAND)
 (RM-5056-PR; AD-635847) CFSTI: HC \$6.00/MF \$0.75

A presentation of mathematical techniques necessary in unique solution of equations of radiative transfer in a homogeneous atmosphere with Rayleigh scattering. The singular linear integral equations for the x- and y-matrices appearing in the azimuth-independent terms of the reflection and transmission matrices for the emerging radiation from a homogeneous, plane-parallel atmosphere with Rayleigh scattering are reduced to four pairs of scalar equations of the forms discussed by T. W. Mullikin. The nonuniqueness in the solutions of one of these pairs of equations is removed by using linear constraints. The solutions are finally expressed as linear combinations of Chandrasekhar's functions and are brought to the same form as that derived by Chandrasekhar, but by completely different methods. The new forms of the solutions are particularly suitable from the computational point of view when large optical thicknesses are involved. Mathematical

expressions corresponding to physical quantities such as directional radiation and total fluxes emerging from a Rayleigh scattering atmosphere are also derived. Author (TAB)

N66-35663*# Avco Corp., Wilmington, Mass. Research and Technology Labs.

FEASIBILITY STUDY OF AN OPTICAL RADIOMETER FOR DETERMINING THE COMPOSITION OF THE MARS ATMOSPHERE FROM SHOCK LAYER RADIATION DURING ENTRY, VOLUME II Final Report

J. A. Hull, R. N. Schweiger, and J. Shumsky May 1966 129 p refs
 (Contract NASw-1208)

(NASA-CR-73027) CFSTI: HC \$3.00/MF \$1.00 CSCL 20F
 This report describes the results of the instrumentation feasibility and development program. The instrument requirements are discussed considering both the experimental and engineering problems. Filters and sensors are examined in detail as to performance and survival of sterilization. Electronic circuitry is described and design considerations leading to choice of optical and electronic system configurations are discussed. A brassboard instrument was constructed and is described with some preliminary calibration and operational data given. An error analysis was performed to establish the accuracy requirements of the measurements. Author

N66-36130*# National Aeronautics and Space Administration, Washington, D. C.

PLANETARY ATMOSPHERES—A CONTINUING BIBLIOGRAPHY, FEBRUARY—MAY 1966

Aug. 1966 135 p refs With Indexes
 (NASA-SP-7017(01)) CFSTI: HC \$1.50/MF \$1.00 CSCL 03B

A continuing annotated bibliography, together with personal author and subject indices, on planetary atmospheres is presented. Most of the entries pertain to investigations of Mars and Venus, many of which are the result of the successful probes of the atmospheres of Venus by Mariner II and Mars by Mariner IV. A limited number of references to the atmospheres of Jupiter, Mercury, and Saturn is also included. References to such specific topics as the theory of planetary origins, extraterrestrial environment, planetary exploration and spacecraft entry, and the physical properties of the planets are provided. Pertinent references to the techniques of planetary observation and measurement, e.g., those involving photography, photometry, spectroscopy, astronomy, and meteorology, are also given. R.N.A.

N66-36942# Observatoire de Paris (France). Section d'Astrophysique.

POLARIMETRIC STUDY OF THE PLANET MARS Final Scientific Report

Audouin Dollfus and John H. Focas 30 Apr. 1966 61 p refs
 (Contract AF 61(052)-508)
 (AFRL-66-492; AD-635928) CFSTI: HC \$3.00/MF \$0.75

Analysis was made of five thousand two hundred measures of the polarized light of Mars, collected during the last nine apparitions of this planet, since 1948. The polarization curves for the bright and the dark areas of the planet are reproduced for each one of the apparitions. The variation of the polarization for the spectral range 1.05 to 0.45 micron is examined. A polarimetric and photometric study of selected samples of minerals indicated the presence, in the bright areas of the planet, of a fine powder of hydrated iron oxide of the limonite type. The seasonal variation of the polarizing properties of the dark areas of Mars follows closely the variation of their darkness at Martian spring; this suggests a seasonal modification of their microscopic contexture. The luminance of the atmosphere of the planet amounts, for a

wavelength of 0.61 micron, to K_a (0.61 Micron) = 0.0006 stilb/phot; this corresponds to a surface pressure of 30 millibars. The scattering coefficient of the atmosphere at 0.47 micron is K_a (0.47 micron) = 0.00151 stilb/phot. This value shows that the atmosphere of the planet is much too transparent in the blue to mask the markings of the soil. Author

N66-37027* # Lockheed Missiles and Space Co., Palo Alto, Calif.

CONVECTIVE AND RADIATIVE HEAT TRANSFER DURING SUPERORBITAL ENTRY

H. Hoshizaki and K. H. Wilson Washington, NASA, Sep. 1966 69 p refs

(Contract NAS7-295)

(NASA-CR-584) CFSTI: HC \$2.50/MF \$0.75 CSCL 20M

The convective and radiative heat transfer to vehicles entering planetary atmospheres at superorbital velocities is investigated. An integral method is employed to determine the radiative and convective heating around a blunt body. The effect of mass injection, radiative emission and absorption, radiation cooling, and coupling between convection and radiation are included in the analysis. The absorption coefficients of the shock-layer gas, as well as the injected ablation products are determined as a function of particle-number density, temperature, and radiation frequency. The results obtained show that self-absorption can reduce the radiative heating by an order of magnitude but has little effect on the convective heating. The nose radius which results in the minimum total heat-transfer rate at the stagnation point is much larger (6 ft to 10 ft diam. at $U_\infty = 50,000$ fps) than the values indicated by an optically thin analysis. It is shown that the total stagnation-point heat-transfer rate is a very weak function of the nose radius, contrary to the results obtained from an optically thin analysis. Author

N66-37122* # Lockheed Missiles and Space Co., Palo Alto, Calif.

SPHERICAL PARTICLE TERMINAL VELOCITIES IN THE MARTIAN DAYTIME ATMOSPHERE FROM 0 TO 50 KILOMETERS

Albert D. Anderson Sep. 1966 37 p refs
(LMSC-6-76-66-21) CSCL 03B

The terminal velocities of spherical particles (density = 3.0 gm cm^{-3}), with diameters from one to 10,000 microns, are presented for seven Martian daytime model atmospheres from 0 to 50 km. The model atmospheres are based on results from the Mariner IV occultation experiment which gave densities in the Martian atmosphere that were much lower than previous estimates. The following conclusions are reached concerning the yellow (dust) clouds: (1) The vertical velocities required to keep yellow-cloud particles of sizes 10μ or less aloft are greater on Mars than on earth; (2) The minimum size of the grains primarily responsible for the local surface yellow-cloud obscurations is about 20 microns. (3) Particles as small as 3 microns could be responsible for the rarer planet-wide obscurations lasting a month or more. It is concluded that the tops of the dust clouds normally extend to the tropopause (5-9 km), which usually limits the convection in the Martian atmosphere. Author

N66-37214* # Stanford Univ., Calif. Radioscience Lab.
THE ATMOSPHERE OF MARS: A COMPARISON OF DIFFERENT MODEL STUDIES BASED ON MARINER IV OCCULTATION DATA Scientific Reports 16 and 3

Gunnar Fjeldbo, Wencke C. Fjeldbo, and Von R. Eshleman Jun. 1966 24 p refs

(Contract NgR-05-020-065; Grant NSG-377)

(NASA-CR-78134; SEL-66-054) CFSTI: HC \$1.00/MF \$0.50 CSCL 03B

Three models for the atmosphere of Mars are compared. In the F_2 models, CO_2 is dissociated by solar ultraviolet radiation at 70 km altitude, and atomic oxygen predominates above 80 km. The principal ion in the daytime ionospheric layer would be O^+ , and the topside of the layer would be isothermal at 90°K . The mesopause temperature minimum would be at or below the freezing point of CO_2 , and dry ice particles would form. In the F_1 models, molecular constituents predominate in the upper atmosphere to 225 km, and molecular ions formed by solar ultraviolet radiation and various chemical reactions would make up the ionospheric layers. The temperature in the isothermal height region would be between 150° and 250°K . In the E model the main ionization layer is formed by solar X-rays in a mixed upper atmosphere. The mass density in the upper atmosphere for the E model would be more than two orders of magnitude larger than for the F_1 models, and about 10^4 times the mass density at the same altitudes in the F_2 models. The F_2 models fit theory and observation best, and identify the reaction which is critical in defining a particular F_2 model. However, an F_1 model might result if photodissociation and diffusive separation are markedly less than would be expected by analogy with the earth's upper atmosphere. Author

N66-37946* # National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

PUBLICATIONS OF GODDARD SPACE FLIGHT CENTER, 1964, VOLUME I: SPACE SCIENCES

[1965] 1636 p ref

(NASA-TM-X-57969) GPO: HC \$8.50; CFSTI: MF \$7.50 CSCL 03B

A collection of articles on astronomy, astrophysics, celestial mechanics, geodesy, solar physics, ionosphere and radio physics, fields and particles, planetology, and planetary atmospheres are presented. For individual titles see N66-37947-N66-37973.

N66-37965* # National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ORIGIN AND EVOLUTION OF ATMOSPHERES AND OCEANS

A. G. W. Cameron, P. J. Brancazio, and N. W. Panagakos *In its* Publ. of Goddard Space Flight Center, 1964. Vol. I: Space Sci. [1965] p 907-911 Submitted for Publication (See N66-37946 23-30) GPO: HC \$8.50; CFSTI: MF \$7.50

Recent evidence for mechanisms which might add to or subtract from the contents of planetary atmosphere and oceans are reviewed. Findings concerning the Earth's atmospheric origins and composition are discussed, with emphasis on isotopic abundance. New data about the atmospheric composition of Mercury, Venus, Mars, Jupiter, and Saturn are mentioned, and uncertainties are pointed out. N.E.N.

N66-38722* # Johns Hopkins Univ., Baltimore, Md.

ULTRAVIOLET MEASUREMENTS IN PLANETARY ATMOSPHERES

William G. Fastie [1966] 29 p refs Submitted for Publication (Grant NSG-193)

(NASA-CR-78485) CFSTI: HC \$2.00/MF \$0.50 CSCL 04A

The impact of the latest optical and electronic component developments on far ultraviolet rocket spectrophotometry is discussed. Results of some recent experiments studying earth airglow and aurorae are reviewed. It is shown that weaker spectral features can be measured in the region 1100 to 3000 Å than at any longer wavelength. Author

N66-38994* # Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE NATURE OF RADIO NOISE EMISSION FROM THE SURFACE OF VENUS

V. M. Vakhnin and A. I. Lebedinskiy *In its Cosmic Res.*, Vol. III, No. 6 [1966] p 177-197 refs (See N66-38986 24-30) CFSTI: HC \$6.00/MF \$1.25

The somewhat high level of radio noise emission of Venus (600°-700°K) can be accounted for by "quiet" or "glow" discharges in the upper atmosphere, which produce a 200°-300°K increase in radio noise above the true thermal emission. The main factor determining the "quiet" or "glow" atmospheric discharge on Venus would not be the electrical-storm phenomena characteristic for the earth, but may be the extremely slow rotation of the planet and the resulting low-turbulence, very intense atmospheric circulation covering almost all of its surface. Calculations of the efficiency with which solar thermal energy is converted into radio-noise energy through intermediate stages—into energy of atmospheric circulation and into electrical-current energy—indicates that the proposed "gas-discharge" model of the radio noise is realistic. Author

**N66-39579# RAND Corp., Santa Monica, Calif.
MANNED SATELLITE OBSERVATIONS AND PLANETARY RESEARCH**

D. Deirmendjian Aug. 1966 12 p refs Presented at the 17th Intern. Astron. Congr., Madrid, 9-15 Oct. 1966 (P-3418; AD-637780) CFSTI: HC \$1.00/MF \$0.50

Certain terrestrial observations from a manned geophysical satellite are considered as a training ground for research on other planets. In particular, it is shown that the experience thus acquired is essential in solving some of the outstanding problems of the Venusian atmosphere by means of a properly designed flyby mission to that planet Author (TAB)

1967

STAR ABSTRACTS

**N67-12052*# Goodyear Aerospace Corp., Akron, Ohio.
STUDY OF EXPANDABLE, TERMINAL DECELERATORS FOR MARS ATMOSPHERIC ENTRY. VOLUME II: SUPPORTING DATA AND TECHNICAL ANALYSIS**
Jay L. Musil 3 Oct. 1966 286 p refs Prepared for JPL (Contracts NAS7-100; JPL-951153) (NASA-CR-79496; GER-12842, vol. II) CFSTI: HC \$6.00/MF \$0.50 CSCL 22B

Aerodynamic characteristics, thermal environment and analytical details, as well as preliminary design, development and testing of expandable, terminal decelerator for application to Mars atmospheric entry are delineated. Also considered are details on: sterilization and materials, decelerator envelope size established by thermal requirements, auxiliary gas-inflation means for the decelerators, and free-flight test simulation. Further technical details are given on weight calculations for several fabric decelerators for a Mars entry capsule. Appendixed is a digital computer program for simulating the motion of re-entry vehicles with either rigidly erected or tethered deceleratory systems. R.LI.

**N67-12109*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPARISON OF ENTRY-BODY SHAPES FOR TOTAL EQUILIBRIUM RADIATION UNDER MARS ENTRY CONDITIONS**

H. J. Stumpf *In its Space Programs Sum. No. 37-40, Vol. IV* 31 Aug. 1966 p 28-31 refs CFSTI: HC\$3.75/MF\$1.25

Summary data are presented on an experimental program being conducted to measure and compare the total (over the whole body) equilibrium shock layer radiative heat transfer for three entry body shapes in a simulated Mars atmosphere. Simulated flight conditions are listed, similar to those expected to be encountered in typical hyperbolic Mars entry trajectories where maximum stagnation point convective or radiative heat transfer occur. The use of a ballistic range, a shock tube, and a shock tunnel for measuring total radiation is proposed; the relative advantages and disadvantages of each method is assessed. Figures depict the blunt cone, modified Apollo, and tension shell entry body shapes. Preliminary data from the ballistic range tests indicate that the modified Apollo shape is subject to much higher equilibrium shock layer radiation than either the blunt cone or tension shell. M.G.J.

**N67-12128*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GAS CHROMATOGRAPHY COLUMN DEVELOPMENT FOR ANALYSIS OF THE MARTIAN ATMOSPHERE**

W. F. Wilhite *In its Space Programs Sum. No. 37-40, Vol. IV* 31 Aug. 1966 p 119-123 CFSTI: HC \$3.75/MF \$1.25

By using a recently-developed porous polymer bead column packing material, resolution of nearly all the components of interest in the Martian atmosphere can be obtained with one gas chromatographic column for a period of less than 15 min. Development of the combined gas chromatograph-mass spectrometer experiment to separate atmospheric constituents is discussed, and the various constituents that require identification are listed. The poor baseline stability that resulted from the use of temperature programming during the separation of N and CO is noted; and the excellent stability obtained through the use of better flow control and a 50-80 mesh Porapak Q is reported. Further improvements permitted the resolution of all components of interest except oxygen, argon, and carbon monoxide which can easily be determined by mass spectrometry. The peak shape for all the components is excellent, except for ammonia and nitrogen dioxide which tail. M.W.R.

N67-12664# Tel-Aviv Univ. (Israel). Inst. of Planetary and Space Science.

**BATSHEVA SEMINAR ON PLANETARY PHYSICS 1966
Final Report, Aug. 1-Sep. 9, 1966**

Uri Shafirir 13 Sep. 1966 69 p refs
CFSTI: HC \$3.00/MF \$0.75

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1. TWO FREQUENCY BEAT OCCULTATION EXPERIMENT FOR A MARS ORBITER Z. Houminer (Natl. Committee for Space Res.) p 11-26 refs (See N67-12665 03-30)
2. MEASUREMENTS OF SURFACE AND ATMOSPHERIC PARAMETERS BY POLARIZATION EXPERIMENTS FROM A MARTIAN ORBITER A. Yaniv and N. Levanon p 27-39 refs (See N67-12666 03-30)
3. MEASUREMENTS OF SURFACE AND ATMOSPHERIC PARAMETERS BY GAMMA-SPECTROSCOPY FROM A MARTIAN ORBITER G. Asaf and S. T. Kruger p 40-45 refs (See N67-12667 03-30)
4. THE MEASUREMENT OF WATER VAPOR ON MARS BY 6.3μ ABSORPTION EXPERIMENT FROM AN ORBITER Y. Ben-Aryeh p 46-49 refs (See N67-12668 03-30)
5. PANEL DISCUSSION: "WHAT SHOULD BE THE PART OF ISRAEL IN SPACE-RELATED ACTIVITIES?" p 50-61

N67-12665# National Committee for Space Research, Tel Aviv (Israel).

TWO FREQUENCY BEAT OCCULTATION EXPERIMENT FOR A MARS ORBITER

Zvi Houminer *In its* Batsheva Seminar on Planetary Phys. 1966 13 Sep. 1966 p 11-26 refs (See N67-12664 03-30) CFSTI: HC\$3.00/MF\$0.75

A two frequency beat occultation experimental procedure for studying planetary atmospheres is described. The techniques can be used by a Mars orbiter. When an orbiter passes behind the planet as viewed from the earth, the radio ray path from transmitter to receiver passes tangentially through the ionosphere and atmosphere and is occulted at the limb. The presence of an atmosphere and ionosphere causes the velocity of propagation of the radio signal to deviate from that in free space, because of the non-unity refractive index of the neutral and ionized media. Calculations for the electron density of the ionosphere, and for the refractivity profile of the neutral atmosphere, are presented. Data results from the Mariner IV occultation experiment are given, and are discussed. It is concluded that the two frequency beat occultation method is a good technique for studying planetary atmospheres because it is simple to perform and does not add much to the orbiter weight. In addition, the method permits diurnal and seasonal changes in different regions of the atmosphere to be studied from a single orbiting satellite. L.S.

N67-12666# Tel-Aviv Univ. (Israel). Inst. of Planetary and Space Science.

MEASUREMENT OF SURFACE AND ATMOSPHERIC PARAMETERS BY POLARIZATION EXPERIMENTS FROM A MARTIAN ORBITER

Akiva Yaniv and Nadav Levanon *In its* Batsheva Seminar on Planetary Phys. 1966 13 Sep. 1966 p 27-39 refs (See N67-12664 03-30) CFSTI: HC\$3.00/MF\$0.75

A means of measuring Martian surface and atmospheric parameters (chemical and physical surface structure, cloudiness and turbidity of the atmosphere, pressure profile of atmospheric density, ice cap composition, and ice cap geometry as a function of season) by light polarization experiments using instrumentation aboard a Martian orbiter space probe, is described. The polarization phenomenon, the instrumentation, and the geometry of the proposed experiment are also described. Tables of polarization data for basalt, granite, quartz sandstone, red sandstone, and water droplets are given. The data indicate how material type, size, roughness, or smoothness, or water vapor affect changes in the polarization readings. L.S.

N67-12667# Weizmann Inst. of Science, Rehovoth (Israel).

MEASUREMENTS OF SURFACE AND ATMOSPHERIC PARAMETERS BY GAMMA-SPECTROSCOPY FROM A MARTIAN ORBITER

Gad Asaf and Steve T. Kruger *In* Tel-Aviv Univ. Batsheva Seminar on Planetary Phys. 1966 13 Sep. 1966 p 40-45 refs (See N67-12664 03-30) CFSTI: HC\$3.00/MF\$0.75

A proposed method of measuring the surface and atmospheric parameters of Mars by means of a gamma ray spectrometer aboard the Voyager orbital mission is discussed. Possible information on the composition and past history of Mars which might be obtained through measurements of the gamma rays emerging from the Martian surface and atmosphere are examined in a general way. Natural radioactivity sources K^{40} , Th^{232} , and U^{235} , and cosmic ray induced radioactivity are discussed. A CsI(Tl) crystal instrumentation system is described; and tables of data regarding radionuclides are given. L.S.

N67-12668# Israel Inst. of Tech., Haifa. Dept. of Physics.

THE MEASUREMENT OF WATER VAPOR ON MARS BY 6.3μ ABSORPTION EXPERIMENT FROM AN ORBITER

Yacob Ben-Aryeh *In* Tel-Aviv Univ. Batsheva Seminar on Planetary Phys. 1966 13 Sep. 1966 p 46-49 refs (See N67-12664 03-30) CFSTI: HC\$3.00/MF\$0.75

An absorption spectroscopic method of quantitatively determining the abundance of water vapor in the atmosphere of Mars from instrumentation aboard an orbiter is suggested. A band model theory for determining the atmospheric transmission function is described; and a geometric diagram of the suggested experiment is depicted. The use of infrared radiometric instruments aboard planetary space probes to measure radiation from the sun is also discussed. L.S.

N67-12754# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER IV MEASUREMENTS NEAR MARS—INITIAL RESULTS: OCCULTATION EXPERIMENT: RESULTS OF THE FIRST DIRECT MEASUREMENT OF MAR'S ATMOSPHERE AND IONOSPHERE

Arvydas Kliore, Dan L. Cain, Gerald S. Levy, Von R. Eshleman, Gunnar Fjeldbo (Stanford Univ.) et al *In* NAS-NRC Extraterrest. Life 1966 p 362-373 refs Reprinted Prepared jointly with Stanford Univ. Available from NAS-NRC, Washington, D. C.: \$6.00

(Contract NAS7-100; Grants NGR-05-020-065; NsG-377)

Changes in the frequency, phase, and amplitude of the Mariner IV radio signal, caused by passage through the atmosphere and ionosphere of Mars, were observed immediately before and after occultation by the planet. Preliminary analysis of these effects has yielded estimates of the refractivity and density of the atmosphere near the surface, the scale height in the atmosphere, and the electron density profile of the Martian ionosphere. The atmospheric density, temperature, and scale height are lower than previously predicted, as are the maximum density, temperature, scale height, and altitude of the ionosphere. Author

N67-13018*# GCA Technology Div., GCA Corp., Bedford, Mass.

TEMPERATURE DETERMINATION OF PLANETARY ATMOSPHERES. OPTIMUM BOUNDARY CONDITIONS FOR BOTH LOW AND HIGH SOLAR ACTIVITY

R. A. Minzner and G. O. Sauermann Feb. 1966 55 p refs (Contract NASw-1225)

(NASA-CR-79525; GCA-TR-66-6-N) CFSTI: HC \$3.00/MF \$0.50 CSCL 03B

One-gas and two-gas methods are proposed for obtaining accurate temperature-altitude profiles. Using atmospheric models for both high and low solar activity, analytical and numerical examinations of the single gas and double gas equations for both high and low altitude reference levels indicate the conditions which optimize each type of calculation. The method depends upon the use of airborne mass spectrometers with detection sensitivities on the order of 10^4 to 10^5 particles per cubic centimeter. To verify the relative suitability of the several approaches, a rigorous error analysis based on the Gaussian method was performed for each case considered. The results show: (1) For optimum conditions, the high altitude reference level should be chosen as the altitude for which the uncertainty in observed number-density data is 100%. (2) Absolute temperature uncertainty is not strongly influenced by variations in number-density models associated with variations in solar activity. (3) The percentage uncertainty at high altitudes, however, is strongly influenced by such variations in number-density models. M.G.J.

N67-15280*# RAND Corp., Santa Monica, Calif.

A NUMERICAL GENERAL CIRCULATION EXPERIMENT FOR THE ATMOSPHERE OF MARS

C. B. Leovy and Y. Mintz Dec. 1966 48 p refs

(Contract NASr-21)

(NASA-CR-81146; RM-5110-NASA) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

A numerical model for simulating the general circulation of the atmosphere of Mars is described and preliminary results from an initial experiment are given. The experimental conditions

correspond to the Northern Hemisphere winter solstice on a planet, in the orbit of Mars, having an atmosphere composed entirely of CO₂ and an initial surface pressure of 5 mb. The important features indicated by the model are development of a fluctuating wave regime in the winter hemisphere, a large amplitude diurnal tide, and condensation of CO₂ to form a winter polar ice-cap. The preliminary character of this experiment is stressed and some future improvements are proposed. Author

N67-15764*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VENUS CAPSULE SCIENCE

R. G. Brereton, R. W. Davies, and C. E. Griffin *In its Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 285-289* refs CFSTI: HC \$3.00/MF \$0.65

Instruments for measuring the altitude dependent physical properties of the Cytherean atmosphere from an entry capsule are described. The purpose of these measurements is to establish an altitude profile of gas density, temperature, pressure, and composition. A suggested capsule scientific payload weighing about 16 lb. is discussed which consists of a thermodynamic variables package, atmospheric composition experiment, impact accelerometer, visual and/or UV photometer, and triaxial accelerometer. A.G.O.

N67-15904*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENTRY CAPSULE ORBIT DETERMINATION ACCURACY
C. Scranage *In its Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 8-12* CFSTI: HC \$3.00/MF \$0.65

The feasibility of an on-board tracking system of two-way coherent doppler between an entry capsule and an orbiting bus for determining the orbit of an entry capsule and estimating atmospheric parameters was studied. Presented is a discussion of entry and impact statistics of the orbital parameters, a description of computer programs and procedures, and a presentation of the estimated uncertainties on the atmospheric constants. Results indicate that: (1) The proposed system is a highly reliable observable for determining the orbit of an entry capsule and estimating atmospheric parameters; and (2) The uncertainties on the estimates of the parameters do not appear to be as dependent on the inherent accuracy of the system as with an Earth-based system. Most significant of the results is that this new observable determined the stratosphere scale height, surface temperature, and stratosphere base temperature to a greater accuracy than was attained by the Mariner IV Mars occultation experiment. S.C.W.

N67-16515*# GCA Technology Div., GCA Corp., Bedford, Mass.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Quarterly Progress Report, 17 Sep.-30 Nov. 1966

F. F. Marmo Dec. 1966 131 p refs

(Contract NASw-1283)

(NASA-CR-81262; QPR-7) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

Technical summaries are presented for studies in photochemistry of planetary gases, planetary aeronomy, and experimental investigations in the VUV (2000-1000 Å) and the EUV (below 1000 Å) spectral regions. Results are discussed for the photochemistry of planetary gases in the EUV and for investigations of ion-molecule reactions in planetary atmospheres. Theoretical studies included work on the cooling rates of hot electrons in the Earth's atmosphere. Absorption and photoionization cross sections were measured for the atomic atmospheric species in the VUV and EUV. The kinetic energy and spatial distribution of ejected photoelectrons due to VUV and EUV photoionization was measured. Experimental devices such as windows, filters, and counters, were designed for use in the VUV and EUV investigations. Significant

progress was achieved on observation of noctilucent clouds in planetary atmospheres. S.P.

N67-16722*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

STUDY OF EQUILIBRIUM AIR TOTAL RADIATION

J. S. Gruszczynski and W. R. Warren, Jr. 1966 51 p refs

(Contract NASw-939)

(NASA-CR-81315) CFSTI: HC \$3.00/MF \$0.65 CSCL 20M

Results are presented from a study of high temperature air radiance applicable to superorbital reentry vehicles. Consideration is given to equilibrium radiation in air and gas mixtures assumed to represent the atmospheres of the near planets. Several theoretical approaches to the problem are reviewed and compared. A shock tube experiment has shown that an electrically driven conventional tube is capable of producing useful model stagnation region test flows to the 60,000 ft/sec flight velocity simulation level. Experimental gas radiance data, obtained in the vicinity of a simulated 38,000 ft/sec flight velocity, show that there is a significant contribution to intensity in the vacuum ultraviolet portion of the spectrum. Also, there appears to be a contribution to intensity in the wavelength region between the quartz and LiF cut-off values. A.G.O.

N67-16801*# National Aeronautics and Space Administration, Washington, D. C.

PROBLEMS IN ASTROPHYSICS. INVESTIGATION OF THE ATMOSPHERES OF VENUS AND MARS

I. K. Koval', ed. Jan. 1967 169 p refs Transl. into ENGLISH of the Book "Voprosy Astrofiziki. Issledovaniye Atmosfer Veneri i Marsa" Kiev, Izd. Naukova Dumka, 1965 Papers Presented at Conf. of the Working Group on Invest. of Venus and Mars, Kiev, Jun. 1964

(NASA-TT-F-394) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

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13. BRIEF ANALYSIS OF A PHOTOMETRIC STUDY OF BRIGHTNESS DISTRIBUTION ACROSS THE MARTIAN DISK I. K. Koval' p 81-84 refs (See N67-16814 07-30)

14. USING SPECTROPHOTOMETRIC DATA TO VERIFY THE HYPOTHESIS OF A LIMONITE COVERING ON MARS I. I. Lebedeva p 85-90 refs (See N67-16815 07-30)

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16. POLARIZATION STUDIES OF RADIO EMISSION FROM THE UPPER LAYER AND SURFACE COVERING OF THE PLANETS A. Ye. Basharinov, M. A. Kolosov, and A. A. Kurskaya p 95-96 refs (See N67-16817 07-30)

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N67-16802*# National Aeronautics and Space Administration, Washington, D. C.

SPECTROSCOPIC INVESTIGATION OF THE COMPOSITION OF THE ATMOSPHERE OF VENUS

V. K. Prokof'yev *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 1-5 (See N67-16801 07-30) CFSTI: HC\$3.00/MF\$0.65*

Basic components of the Venutian atmosphere, as determined by spectroscopic studies, are discussed. The hypothesis that nitrogen is the main atmospheric component is considered fairly well ascertained; and attention is given to the carbon dioxide, oxygen, water vapor, and other gaseous components. Various investigations are mentioned, including the interpretation of a banded structure as a formaldehyde emission. It is acknowledged that the spectrum of Venus is not an exact duplicate of the solar spectrum, and that there are data to indicate that absorption in carbon dioxide bands undergoes changes. M.W.R.

N67-16803*# National Aeronautics and Space Administration, Washington, D.C.

NOCTURNAL AIRGLOW OF VENUS

N. A. Kozyrev *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 6 (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65*

Spectral observations indicate that the Venus night airglow is composed of both luminescence from the lower atmospheric layers that is uniformly distributed over the dark side, as well as ionospheric luminescence that presents a narrow ring at the edge of the planet. The luminescence from the lower atmospheric layers, the more probable of the two, has the spectrum of formaldehyde and is probably the result of hydrocarbon oxidation in the interior of the surface of Venus. Ionospheric luminescence is observed to change, and there appears to be no relationship between such luminescence and solar activity. Emission lines of hydrogen, or carbon dioxide under the influence of high energy particles. M.W.R.

N67-16804*# National Aeronautics and Space Administration, Washington, D. C.

THE IONOSPHERIC HYPOTHESIS OF RADIO EMISSION FROM VENUS

A. D. Danilov and S. P. Yatsenko *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 7-12 refs (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65*

The hypothesis proposed by Strelkov that the high temperatures of centimeter radio waves emitted from Venus is explained by radioactive heating of the planetary surface is discussed. The hypothesis is weakened by observations that indicate Venus has a thick ionosphere. Detailed analysis shows that the ionospheric model may be used as a basis for a complete explanation of the spectrum of brightness temperatures observed in the radio emission from Venus, although a much stronger energy source would be needed than that provided by the Earth's ionosphere. Available data show a possible correlation between solar activity and the brightness temperatures of centimeter radio emission from Venus. A positive confirmation of this correlation would be an important factor in explaining the mechanism responsible for this radio emission. Author

N67-16805*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF VENUS CLOUD COVER ON RADIO EMISSION OF THE PLANET IN THE CENTIMETER AND MILLIMETER BANDS

G. M. Strelkov *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 13-37 refs (See N67-16801 07-30) CFSTI: HC\$3.00/MF\$0.65*

An atmospheric model with structural parameters determined by astronomical observations is used to explain the high effective temperature of radiation emission from Venus in the centimeter band. It is assumed that the cloud cover of Venus has a 3 km layer of water droplets under an 8 km layer of ice crystals; and spectral characteristics of the brightness temperature for 0.3 to 22 cm emissions were calculated for surface pressures of 5 and 10 atm. Comparison of these characteristics with measured data at various wavelengths indicates that the planetary cloud cover contains neither water nor solid nonconductive powders. Emission from the heated interior is considered as an explanation for the high effective temperature of radio emission from Venus in the centimeter range; with the depths of these layers dependent upon optical thickness of the rocks making up the planetary crust. High temperature gradients in the subsurface layers of the soil are not considered to be involved. M.W.R.

N67-16806*# National Aeronautics and Space Administration, Washington, D. C.

RESULTS FROM A PRELIMINARY ANALYSIS OF SOME SPECTROGRAMS OF VENUS TAKEN IN APRIL 1964

V. V. Avramchuk and I. K. Koval' *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 38-42 refs (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65*

A spectrogram of Venus taken on April 21, 1964, reveals a bright detail with a diameter of approximately 4 in; with the spectrograph slit oriented along the line through the horns of the crescent close to the middle zone of the terminator. This spot is well defined in the ultraviolet region, gradually fades toward the long wave end of the spectrum, and vanishes at $M=\mu$. Another spectrogram taken April 27, with slit orientation along the intensity equator was analyzed to determine the energy range in the 370 to 500 $M=\mu$ range. A considerable drop in the curve for monochromatic albedo is noted for the point on the limb toward the ultraviolet end of the spectrum; and there is a lesser drop for the terminator. The difference in the curves of monochromatic albedo for the limb and terminator of Venus may explain the change in the color of the planet with phase, as well as the difference in violet absorption observed at different times. M.W.R.

N67-16807*# National Aeronautics and Space Administration, Washington, D. C.

OPTICAL PROPERTIES OF THE MARTIAN ATMOSPHERE FROM DATA OF PHOTOMETRIC OBSERVATIONS

N. P. Barabashov *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 43-51 refs* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

An analysis of photometric data for Mars based on the theory of light scattering in planetary atmospheres indicates that the atmosphere probably has a low optical thickness. The scattering properties of the Martian atmosphere are chiefly in the visible region of the spectrum. The true absorption increases toward the short-wave end of the spectrum, although even here the optical thickness of the atmosphere is relatively low. Many areas in maria show a greenish hue. Author

N67-16808*# National Aeronautics and Space Administration, Washington, D. C.

SOME REMARKS ON HYPOTHESES OF AN ABSORPTIVE ATMOSPHERE ON MARS

V. V. Sharonov *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 52-60 refs* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

Models for the atmosphere and surface of Mars are reviewed that assume that the atmosphere has absorptive rather than scattering properties and that the red color of the planet is due to selective absorption in the atmospheric layer. The Carrer-Kiess hypothesis, which attributes selective extinction to nitrous oxide in the Martian atmosphere, is inadmissible since the absorption band for this compound in the spectrum of the planet is either absent or extremely weak. The model proposed by N. A. Kozyrev is not in accord with the observed brightness distribution along the radius of the disk as has already been pointed out in a number of articles. Opik's calculations are self-consistent, although they assume optical properties in the atmosphere that have no sound physical basis. It is considered extremely improbable that the Martian atmosphere has absorptive properties. Author

N67-16809*# National Aeronautics and Space Administration, Washington, D. C.

A MODEL FOR THE MARTIAN ATMOSPHERE AND PLANETARY SURFACE FROM THE STANDPOINT OF A HYPOTHESIS ASSUMING AN ATMOSPHERE WITH PURELY SCATTERING PROPERTIES

V. V. Sharonov *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 61-65 refs* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

The author reviews the state of the art in attempts to apply photometric data for explaining the nature of Mars. It is pointed out that this problem has no unique solution since the relationship between brightness across the disk and optical characteristics of the atmosphere depends on atmospheric composition and structure. Thus all calculations of atmospheric characteristics such as optical thickness, mass and surface pressure are always based on some predetermined model. Since there is an infinite selection of possible models, analogy with terrestrial conditions is assumed to be most probable. This point of view gives preference to a model in which the visible region of the atmospheric spectrum is assumed to have purely scattering properties and the surface is considered to be covered with limonite dust. The nature of the polar caps and the violet layer are problems which are still unsolved. Author

N67-16810*# National Aeronautics and Space Administration, Washington, D. C.

SOME CONSIDERATIONS OF THE AEROSOL COMPONENT OF THE MARTIAN ATMOSPHERE

N. N. Sytinskaya *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 66-68* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

Particles suspended in a gas may have a strong effect on the scattering properties of the medium without changing its mass and density to any great extent. For this reason, photometric data on mass, density and surface pressure for the Martian atmosphere must be analyzed to isolate the contributions from gas and aerosol to the brightness of the atmospheric layer. Since there have been no satisfactorily reliable methods proposed for this purpose, the author reverses the process and uses pressure data obtained by other methods for a photometric study of the suspended particles. Author

N67-16811*# National Aeronautics and Space Administration, Washington, D. C.

ON THE AEROSOL COMPONENT OF THE MARTIAN ATMOSPHERE

E. G. Yanovitskiy *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 69-78 refs* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

Consideration is given to the discrepancy between data for the atmospheric pressure on the Martian surface from spectroscopic measurements and data for this pressure according to photometric and polarimetric observations. This difference is explained by the fact that light scattering by aerosol particles with radii $r \leq 10^{-6}$ cm is not considered when using photometric and polarimetric observations for determining surface pressure. The terrestrial atmosphere is used as an example to confirm this assumption. It is found that the number of aerosol particles with radii of the order of 10^{-6} cm in a column of Martian atmosphere with a base of 1 cm^2 is 10^{15} 1/cm^2 . It is shown that the Martian atmosphere has a higher saturation of fine particles of aerosol per unit of mass than that of the Earth. Author

N67-16813*# National Aeronautics and Space Administration, Washington, D. C.

CHEMICAL COMPOSITION, PRESSURE AND TEMPERATURE OF THE MARTIAN ATMOSPHERE FROM DATA OF INFRARED SPECTROSCOPY

V. I. Morov *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 80* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

Infrared spectroscopy of Mars revealed a series of new $\text{C}^{12}\text{O}_2^{16}$ bands, the $\text{C}^{13}\text{O}_2^{16}$ band, and four new unidentified bands. The $\text{C}^{12}\text{O}_2^{16}$ bands at 1.6 and 2.05μ give a product of CO_2 by pressure equal to $170 \text{ g/cm}^2 \text{ mbar}$; and other studies have indicated the pressure in the Martian atmosphere is about 15 mbar close to the surface. It is, therefore, assumed that the pressure is in the 10 to 30 mbar range, which is considerably lower than previous estimates from photometric and polarization data.

N67-16817*# National Aeronautics and Space Administration, Washington, D. C.

POLARIZATION STUDIES OF RADIO EMISSION FROM THE UPPER LAYER AND SURFACE COVERING OF THE PLANETS

A. Ye. Basharinov, M. A. Kolosov, and A. A. Kurskaya *In its Probl. in Astrophysics. Invest. of the Atmospheres of Venus and Mars Jan. 1967 p 95-96 refs* (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

Polarization studies of inherent and reflected radio emission in the centimeter and decimeter bands were used to obtain information on the structure of the upper layer and surface coverings of the planets. Polarization properties of the inherent radio emission from the moon in the centimeter range were used to obtain a

more precise determination of the dielectric constant, and to evaluate the roughness of the upper surface layer. Similar data were obtained from polarization studies of radio echoes from Venus on a 12 cm wavelength. Instrumentation used for the polarization studies are mentioned; and other polarization data in the SHF range are briefly reviewed. L.S.

N67-16820*# National Aeronautics and Space Administration, Washington, D. C.

TAKING ACCOUNT OF SCATTERING ANISOTROPY IN DETERMINING THE OPTICAL PARAMETERS OF THE MARTIAN ATMOSPHERE AND SURFACE

A. V. Morozhenko and E. G. Yanovitskiy *In its Probl. In Astrophysics. Invest. of the Atmospheres of Venus and Mars.* Jan. 1967 p 110-114 refs (See N67-16801 07-30) CFSTI: HC \$3.00/MF \$0.65

Absolute photometric data for spherical and elongated indicatrices are used for determining the optical parameters of the Martian atmosphere and surface. A comparison of these parameters shows that the optical thickness increases considerably with elongation of the scattering indicatrix (if the albedo for single scattering is close to unity). Author

N67-17629*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

PREDICTIONS OF SHOCK-LAYER RADIATION FROM MOLECULAR BAND SYSTEMS IN PROPOSED PLANETARY ATMOSPHERES

Henry T. Woodward Washington, NASA, Feb. 1967 49 p refs (NASA-TN-D-3850) CFSTI: HC \$3.00/MF \$0.65 CSCL 03A

Concentrations of radiating molecules and radiation from a number of band systems are presented for equilibrium shock-layer temperatures and densities of vehicles entering proposed Martian and Venusian atmospheres. The atmospheres selected consist of various proportions of CO₂, N₂, and A. Charts relate these equilibrium shock-layer properties to flight velocity and ambient density through the normal shock conservation equations. These data can be used to estimate stagnation-point radiative heat transfer for entry trajectories. Estimates for some flight conditions are discussed and compared. Author

N67-17793*# Johns Hopkins Univ., Baltimore, Md.

ULTRAVIOLET MEASUREMENTS IN PLANETARY ATMOSPHERES

William G. Fastie *In NASA. Electron. Res. Center Aerospace Meas. Tech.* 1967 p 203-216 refs

GPO: HC \$1.00; CFSTI: MF \$0.65

The techniques and optical components which are employed in ultraviolet space measurements are described, and some of the experimental data which have been obtained are presented. The instrumentation considered is applicable to all spectral ranges above the cutoff wavelength of lithium fluoride windows at about 1050 Å. Specific areas receiving emphasis include energy relationships, unit of brightness, differential filter photometry below 2000 Å. Ebert spectrometer properties, measuring circuits, and collecting optics. A.G.O.

N67-18273*# National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York.

THE ATMOSPHERE OF MERCURY

S. H. Gross (Airborne Instr. Lab.), W. E. McGovern, (N. Y. Univ.), and S. I. Rasool Jan. 1966 54 p refs Submitted for Publication (Grant NSG-499) (NASA-TM-X-57322) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

Available information on the temperature, composition, and surface pressure of Mercury's atmosphere is reviewed and the

implications of a nonsynchronous rotation of the planet on the atmosphere are discussed. Several atmosphere models consistent with observations are constructed in an attempt to determine if they are stable against depletion of the atmosphere by gravitational escape. Results are discussed from the viewpoint of the atmospheric surface. R.N.A.

N67-18280*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ON THE LIMB DARKENING OF PLANETARY ATMOSPHERES IN THE THERMAL INFRARED

Robert E. Samuelson [1965] 12 p refs Submitted for Publication (NASA-TM-X-57359) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

Thermal maps of Venus and Jupiter have demonstrated that limb darkening in the 8 to 14 micron wavelength interval is pronounced for these two planets. Since both planets are completely cloud covered, it is possible that both anisotropic multiple scattering and a temperature gradient are responsible. An attempt is made to demonstrate how exact solutions to the standard problem, that of describing the angular distribution of outgoing radiation from a slab of material bounded on both sides by a vacuum, may be expressed in terms of Chandrasekhar's ψ and ϕ functions of zero order when both scattering and temperature gradient effects are present. Author

N67-18435* National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York.

EARTH AND VENUS—THE SISTER PLANETS?

R. Jastrow and S. I. Rasool Feb. 1966 32 p refs Submitted for Publication (NASA-TM-X-57351) CFSTI: \$3.00 CSCL 03B

Various features of Venus, including its climate, surface temperature, atmosphere, greenhouse effect, radiation, CO₂ and water vapor content, surface characteristics derived from radar observations, and rotation are discussed and compared with those of the Earth. R.N.A.

N67-18652* National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York

THE UPPER ATMOSPHERE OF MARS

S. H. Gross (Airborne Instr. Lab.), W. E. McGovern (New York Univ.), and S. I. Rasool [1965] 16 p refs Submitted for publication (NASA-TM-X-57327) CFSTI: \$3.00 CSCL 03B

The thermal structure of the upper atmosphere of Mars has been theoretically investigated. It is found that the exospheric temperature, for a pure CO₂ model atmosphere, lies between 400-700°K. The origin of the Martian atmosphere is discussed in the light of these results. Author

N67-19022*# National Aeronautics and Space Administration, Washington, D. C.

SIGNIFICANT ACHIEVEMENTS IN SPACE SCIENCE, 1965

Homer E. Newell 1967 222 p refs (NASA-SP-136) GPO: HC \$1.00; CFSTI: MF \$0.65 CSCL 03B

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3. PARTICLES AND FIELDS A. W. Schardt and A. G. Opp p 31-88 refs (See N67-19025 08-29)
4. PLANETARY ATMOSPHERES R. Horowitz, R. F. Fellows, and H. Hipsher p 89-111 refs (See N67-19026 08-30)

5. PLANETOLOGY M. W. Molloy and U. Liddel p 113-195
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and H. J. Smith p 197-218 refs (See N67-19028 08-29)

N67-19026* National Aeronautics and Space Administration,
Washington, D. C.

PLANETARY ATMOSPHERES

Richard Horowitz, Robert F. Fellows, and Harold Hipsher *In its*
Significant Achievements in Space Sci., 1965 1967 p 89-111
refs (See N67-19022 08-30) GPO: HC \$1.00; CFSTI: MF
\$0.65

A description of the diurnal density bulge in the Earth's
atmosphere involving composition, temperature, and airglow is
presented. Tabulated are the number densities of the neutral
atmospheric constituents. Experiments aboard Explorer XVII represent
the first attempt toward measuring on a global scale the
composition of the neutral atmosphere and its temporal variations.
The thermosphere probe temperature measurements, based on
the scale height of the molecular-nitrogen density obtained under
different atmospheric conditions, are summarized. Sodium release
during rocket flights has revealed that strong shear zones exist at
altitudes from 70 to 120 kilometers. A wavelike structure has
been detected in some neutral temperature profiles, possibly revealing
the presence of gravity waves. Simultaneous measurements of
midlatitude night airglow and particle precipitation indicate that the
midlatitude 5577 Å night airglow is not excited by charged particle
bombardment as it is in auroras. Spectroscopic measurements
made during the recent Mars opposition yield values between 7
and 13 millibars for the surface pressure. Radio measurements of
Venus indicate a surface temperature of approximately 600°K and
a surface pressure ranging from ≈ 10 to ≈ 200 Earth atmospheres.
S.P.

N67-19113* Yale Univ., New Haven, Conn.

SPACE RECEIVER OBSERVATIONS OF JOVIAN DECAMETER FLUX Progress Report

Louis Pataki [1966] 7 p

(Grant NSG-407)

(NASA-CR-82654; PR-3) CFSTI: \$3.00 CSCLO3B

A third flux monitoring station was set up which led to
confirmation of the velocity of the interplanetary electron clouds
responsible for the second long L-pulses. The addition of this
station has led to a study of the direction of this motion, and will
allow the calculation of the shape of the irregularities in the
interplanetary medium. Described are techniques used to analyze
either spherical or randomly oriented irregularities causing the
L-pulses. As a basis for first analysis the contours of correlation
are treated as circular. Data on the directions of the velocity vector
in the plane perpendicular to the line of sight of Jupiter are
presented for the event of October 23, 1965. Velocity data obtained
from the three stations was in agreement. This indicates that
even if the correlation contours are elliptical and not strictly circular,
their motion is not such as would give a misleading projected
velocity between two stations. An extension of the theory derived
for ionospheric work and its casting in a form suitable for computer
analysis is under way. This will allow calculation of the shape of
the correlation contours and thus of the mean shape of the
irregularities in the interplanetary medium. Records are being digitized
for this purpose. It is surmised that their analysis will give data
at various values of hour angle and Jovian longitude thus allowing
a careful analysis of the interaction of the L-pulse phenomena
with other astronomical parameters. S.C.W.

N67-19543# Air Force Systems Command, Wright-Patterson
AFB, Ohio. Foreign Technology Div.

ON TWILIGHT INVESTIGATIONS OF PLANETARY ATMOSPHERES FROM SPACE SHIPS

G. V. Rozenberg 17 Jun. 1966 20 p ref Transl. into ENGLISH
from Izv. Akad. Nauk SSSR, Fiz. Atmosfery i Okeana (USSR), v.
1, no. 4, 1965 p 377-385

(FTD-MT-65-400; TT-66-62496; AD-640725) CFSTI: HC
\$3.00/MF \$0.65

Translation of Russian research: On Twilight Investigations
of Planetary Atmospheres from Space Ships. TAB

N67-19904* Stanford Research Inst., Menlo Park, Calif.

CHEMICAL ORIGIN OF THE VENUSIAN CLOUDS Interim Report, 1 Oct. 1966-30 Jan. 1967

R. C. Robbins 24 Feb. 1967 12 p refs

(Contract NASr-49(25); SRI Proj. PAU-6128)

(NASA-CR-82960; IR-2) CFSTI: HC \$3.00/MF \$0.65 CSCI
03B

A laboratory study was made of chemical reactions which
may be important in the atmosphere of Venus. It has been found
that the reaction between excited hydrogen atoms and carbon
monoxide yields intermediate radical and atom species which undergo
rapid secondary reactions to produce water and organic compounds.
The principal organic compounds formed are ethylene, formaldehyde,
and glyoxal, all readily polymerizable substances. Since the reaction
course proceeds in this fashion under laboratory conditions, with
the formation of these reactive monomers, it is altogether possible
that the same reactions and products are important in the high
Venus atmospheres. Author

N67-19929* Geophysics Corp. of America, Bedford, Mass.
Technology Div.

EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY

F. F. Marmo Sep. 1966 84 p refs

(Contract NASw-1283)

(NASA-CR-82937; GCA-TR-66-19-N) CFSTI: HC \$3.00/MF \$0.65
CSCI 04A

Summaries, bibliographies, and abstracts of individual
publications on the physics of planetary atmospheres are presented
along with technical summaries of unpublished results. The broad
variety of scientific areas which have been considered are discussed
under the following major categories: (1) photochemistry of
planetary atmospheres, (2) theoretical studies, (3) laboratory
investigations in the vacuum and extreme ultraviolet spectral regions,
and (4) planetary aeronomy. A.G.O.

N67-20169* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE UTILIZATION OF POWDERED METALS AS FUELS IN THE ATMOSPHERES OF VENUS, EARTH, AND MARS

R. A. Rhein 28 Feb. 1967 15 p refs

(Contract NAS7-100)

(NASA-CR-82878; JPL-TR-32-1073) CFSTI: HC \$3.00/MF \$0.65
CSCI 21B

The ignition temperatures of a number of powdered metals
have been measured in air, in a simulated Venus atmosphere, and
in a simulated Mars atmosphere. Each atmosphere was thought
to consist of mixtures of argon, carbon dioxide, and nitrogen. This
study was conducted to show that the atmospheres of the planets
Mars and Venus might be utilized as sources of oxidizers for
chemical energy. The heat liberated from the combustion of lithium,
beryllium, and boron in the simulated Venus and Mars atmospheres
was calculated from the compositions of the products formed
from the combustion of these metals in the simulated Venus and
Mars atmospheres. The product compositions were determined by
chemical analysis. Author

N67-21180* Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena.

THE MARS 1964-1965 APPARITION

C. F. Capen 15 Dec. 1966 204 p refs
(Contract NAS7-100)
(NASA-CR-83123; JPL-TR-32-990) CFSTI: HC \$3.00/MF \$0.65
CSCLO3A

A multicolor photographic and visual patrol of the planet Mars was carried out for an entire terrestrial year that covered the Martian northern hemisphere spring and summer during the 1964-1965 apparition. The spectral range of the photographic program included the ultraviolet, visual, and infrared in seven discrete pass-bands. The nightly visual record was obtained with the aid of six color filters spaced across the visual spectrum. Good observational coverage was obtained of the Mariner IV scan region (110°-200° long.) before, during, and after the photographic contact of July 15, 1965 UT, in an effort to predict and describe atmospheric and surface conditions during encounter. A summary of Martian seasonal events is given. Martian polar regions are explored and North Polar Cap regression curves obtained from orange-red and green plate measurements are presented. Atmospheric and meteorological observations are thoroughly analyzed. A daily observation report of surface conditions and atmospheric phenomena, a Mars pictorial atlas, and Mariner IV photographic data are presented.

Author

N67-22562# RAND Corp., Santa Monica, Calif.
A NEW APPROACH TO THE AUXILIARY EQUATION WITH APPLICATION TO THE GREENHOUSE EFFECT

H. H. Kagiwada, R. E. Kalaba, and Rupert Wildt Jan. 1967
20 p refs

(Contract AF 44(640)67-C-0045)
(RM-5076-PR; AD-645565) CFSTI: HC \$3.00/MF \$0.65

Part of the heating of the atmosphere is due to the fact that the incident solar radiation has one absorption coefficient and the escaping planetary gas another. This is referred to as the greenhouse effect. An idealized theory of the greenhouse effect for a gray planetary atmosphere of infinite depth was developed by R. Wildt of Yale University in previous work. Numerical results for the temperature profile were given. These employed accurate numerical values for the Hopf q function and the Chandrasekhar H function, which are now available. This memorandum shows how to treat the problem for the case of an atmosphere of finite depth. First an initial value problem for the basic integral equation for the source function is obtained. Then an effective numerical procedure is described, and some computational results are presented.

Author (TAB)

N67-22577# RAND Corp., Santa Monica, Calif.
INTRODUCTORY COMMENTS ON VENUS LOWER ATMOSPHERE

D. Deirmendjian Jan. 1967 10 p Presented at Conf. on the Atmospheres of Mars and Venus, Tucson, Ariz., 28 Feb. 1967
(P-3513; AD-645956) CFSTI: HC \$3.00/MF \$0.65

The difficulties in distinguishing between an upper and lower Venusian atmosphere are pointed out. The lack of reliable basic data, such as surface pressure and temperature, temperature gradients, gaseous and particulate composition, large and small scale air motion, related to the denser parts of the atmosphere are noted. The wide variation of surface pressure estimates, ranging between 3 and 1000 atmospheres, advanced by various authors recently is displayed graphically. No critique of these is attempted because the corresponding models are not sufficiently well defined nor thoroughly analyzed.

Author (TAB)

N67-23302*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
THE STRUCTURE OF AN ATMOSPHERE FROM ON-BOARD MEASUREMENTS OF PRESSURE, TEMPERATURE, AND ACCELERATION

Simon C. Sommer, Alfred G. Boissevain, Layton Yee, and Roger C. Hedland Washington, NASA, Apr. 1967 56 p refs
(NASA-TN-D-3933) CFSTI: HC \$3.00/MF \$0.65 CSCLO3B

A method has been developed for determining the structure of a planetary atmosphere from measurements of pressure, temperature, and acceleration made on board an entry vehicle. Determination of the average molecular weight of the atmosphere is an important by-product of this type of measurement. Data obtained from drop tests of instrumented capsules into the earth's atmosphere from high altitude have been analyzed. The atmosphere structure and the vehicle trajectory determined from these data are in excellent agreement with those obtained from ground-based observations and meteorological measurements. The deduced molecular weight was within 3 percent of the average value of air.

Author

N67-23425# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON THE SCATTERING OF LIGHT IN PLANETARY ATMOSPHERES. ON THE PROBLEM OF DIFFUSE REFLECTION OF LIGHT BY A TURBID MEDIUM

V. A. Ambartsumyan [1966] 36 p refs Transl. into ENGLISH from Russian /*its Astron. Papers Translated from the Russian*, No. 7

The problems of scattering of light in planetary atmospheres and diffuse reflection of light by a turbid medium are considered. An integral equation from scattering theory for the case of spherical indicatrix is given, and its solution reduces the problem to a functional equation that is easy to solve numerically. Results obtained are used to determine the distribution of intensity over the disk of a planet at different phases. A particularly simple result is obtained for the case when the planet is in opposition. From the auxiliary functions introduced the plane albedo of the medium, i.e., the ratio of the flux scattered by the medium to that incident on it, is determined. The problem of diffuse reflection of light by a medium which both scatters and absorbs light is solved with a new method that leads to a linear integral equation. This method does not resort to the calculation of quantities which characterize the behavior of light within the medium, and it allows confinement to an analysis of the conditions at the boundary.

S.P.

N67-23655*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED CONCEPTS

In its Supporting Res. and Advanced Develop. 28 Feb. 1967
p 202-223 refs

Apparent optical properties of window-covered spherical cavities are reported along with an illustration of the Greenhouse effect. Results obtained with an annular hohlraum are given for the thermal radiation from ionized argon, and a nonrotating Rankine cycle liquid metal magnetohydrodynamic (MHD) system is under investigation. This liquid MHD power conversion system uses lithium that is accelerated by cesium vapor in a two-phase nozzle, separated from the cesium, decelerated in an MHD generator, and returned to the nozzle by a diffuser and heat source. Gaseous breakdown from an applied electric field for three component gases are studied as possible atmospheres of Mars and Venus. Paschen curves for the gas mixtures and for extra high purity dry nitrogen and spectroscopic grade argon are included. Despite the similarity between the curves for the proposed planetary atmospheres and the nitrogen, it is noted that a slight amount of impurity of an unknown minor constituent could have considerable effect on the breakdown potential.

M.W.R.

N67-23660*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES

R. H. Norton *In its* Supporting Res. and Advanced Develop. 28 Feb. 1967 p 293-305 refs

The Coudé facility for the Table Mountain Observatory 24-inch telescope is described, and observations are reported for the radio emission from Venus at 1.5 cm wavelength by using a tunable, narrow passband Dicke-type radiometer. For the latter, brightness temperatures of Venus cannot be determined from the autumn measurements because of effects from the Sun in the far sidelobes of the antenna and too-large antenna offsets during the observing cycle. The emission feature near 23.00 GHz for the spring data appears to be more pronounced relative to neighboring points as the illumination of the Venusian disk increases, and atmospheric extinction appears near the center of the water line. The effects of thermally nonuniform sources on the emission spectra of silicates are investigated to shed light on planetary petrology and mineralogy.

M.W.R.

N67-24229# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

DETERMINATION OF THE BRIGHTNESS OF THE ATMOSPHERE OF THE PLANET MARS

A. Dollfus Jul. 1966 13 p refs Transl. into ENGLISH from Compt. Rend. Soc. (Paris), v. 262, ser. B, 14 Feb. 1966 p 519-522 (TR-34) CFSTI: HC \$3.00/MF \$0.65

The measurements of the variation of polarization of light of the planet Mars between the center and the edge of its disk gives the brightness of the atmosphere, in the absence of haze or clouds, as 6×10^{-4} sb/phot. If the air is devoid of aerosols, the pressure at the surface should be 30 mb.

Author

N67-24309# National Aeronautics and Space Administration, Washington, D. C.

NASA AND THE MANNED SATELLITE PROGRAM

Morris Tepper In Natl. Center for Atmospheric Res. Satellite Data in Meteorol. Res. Dec. 1966 p 333-340

NASA's flight program plans for the Tiros/TOS satellites, Applications Technology Satellites, and Manned Meteorology Satellites; and projected post-1970 flight programs; are summarized. Also reviewed are procedures for participating in space flight investigations, and the requirement for meteorological research on Mars.

S.C.W.

N67-25054*# SDS Scientific Data Systems, Pomona, Calif.
IMPROVED ION SOURCES

Washington, NASA, May 1967 61 p refs
(Contract NAS5-3453)

(NASA-CR-7754) CFSTI: HC \$3.00/MF \$0.65 CSCL 20F

A study was performed of ion sources having a magnetically aligned electron beam, and which are compatible with a previously designed quadrupole mass spectrometer for planetary atmospheric analysis. A primary objective was to use the rigid alignment of the electron beam to minimize electron bombardment of the ion source surfaces thereby removing one of the obstacles to stable, long-term operation. A second objective was to formulate the relationships of size, pressure, electron current and applied potentials for a simple model of a magnetic ion source in order to scale the dimensions and pressure over wide ranges. Using derived scaling factors a crossed magnetic field ion source was designed for operation at 10^{-1} torr internal pressure. A model, having an internal volume of 4.7×10^{-3} cubic centimeters and tunnel apertures of 0.0025 centimeter diameter was constructed and subjected to test.

Author

N67-25092*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-43, VOLUME VI FOR THE PERIOD NOVEMBER 1, 1966 TO DECEMBER 31, 1966. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES

31 Jan. 1967 32 p
(Contract NAS7-100)

(NASA-CR-83745; JPL-SPS-37-43, Vol. VI) CFSTI: HC \$3.00/MF \$0.65 CSCL 22B

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1. SURVEYOR PROJECT: THE LUNAR PROGRAM p 1-6 (See N67-25093 13-31)
2. MARINER VENUS 67 PROJECT: THE PLANETARY-INTERPLANETARY PROGRAM p 7-11 (See N67-25094 13-31)
3. MARINER MARS 1969 PROJECT: THE PLANETARY-INTERPLANETARY PROGRAM p 12-14 (See N67-25095 13-31)
4. DSN CAPABILITIES AND FACILITIES. THE DEEP SPACE NETWORK p 15-16 (See N67-25096 13-31)
5. DSIF DEVELOPMENT AND OPERATIONS. THE DEEP SPACE NETWORK p 17-22 (See N67-25097 13-31)

N67-25094*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER VENUS 67 PROJECT: THE PLANETARY-INTERPLANETARY PROGRAM

In its Space Programs Sum. No. 37-43, Vol. VI 31 Jan. 1967 p 7-11 (See N67-25091 13-31)

Various design changes in the Mariner spacecraft are reported on the Venus 67 project. Such changes to the spacecraft were necessitated by the fact that the M67-2 flight spacecraft travel is oriented toward, rather than away from, the Sun. Also, conversions to accommodate the revised encounter sequencing and science payload were taken into account. Brief technical details are given on the attitude-control subsystem, planet sensor, sun shade, and space simulator radiometers.

R.LI.

N67-25095*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MARINER MARS 1969 PROJECT: THE PLANETARY-INTERPLANETARY PROGRAM

In its Space Programs Sum. No. 37-43, Vol. VI 31 Jan. 1967 p 12-14 (See N67-25091 13-31)

In connection with the Mariner Mars 1969 Project, the initial formal issue of the spacecraft design book, containing system and subsystem functional requirements and defining the system design, was completed. Technical details are given on orbit determination, planetary quarantine, and central computer and sequencer for guidance and control.

R.LI.

N67-25097*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DSIF DEVELOPMENT AND OPERATIONS. THE DEEP SPACE NETWORK

In its Space Programs Sum. No. 37-43, Vol. VI 31 Jan. 1967 p 17-22 (See N67-25091 13-31)

Technical details are presented on various NASA Programs, including their instrumentation developments, and design modifications. Some of those reported are: Surveyor Project, Mariner Mars 1964 Project, Lunar Orbiter Project, and Pioneer Project. DSS equipment installation and testing results are given on Pioneer, Echo, Venus, and Mars DSS. Brief details are also reported on communications development and testing.

R.LI.

N67-26454*# Army Missile Command, Huntsville, Ala.

MERCURY ATMOSPHERE AND SURFACE

Herbert H. Hoop 31 Jan. 1967 86 p refs
(NASA-CR-84113; RSIC-633) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

This summary and bibliography is a selection of the more accepted literature from the sizable quantity which covers the range of hypotheses as to rotation of the planet Mercury, temperature,

atmosphere, surface, and terrain. Various hypotheses and the few generally accepted facts are discussed. Included is a selected bibliography and author index. Author

N67-26461# Boeing Scientific Research Labs., Seattle, Wash.
GEO-ASTROPHYSICS LABORATORY REVIEW, JANUARY-JUNE 1966

Jun. 1966 25 p refs

CFSTI: HC\$3.00/MF\$0.65

The work on geomagnetic micropulsations has proceeded to the point where seasonal variations in the diurnal rate of occurrence of the high-frequency component, i.e., the so-called pearls in the frequency regime 0.2-2.0 Hz, are apparent. A limited amount of data has also been obtained from stations near the north and south geomagnetic poles. Experimental and theoretical investigations established conclusively that plane-wave theory in scattering of electromagnetic radiation by random media is inadequate, and that it is necessary to consider spherical waves. Experimental work and associated analysis have continued in fields of radio star scintillations, photoionization, and photodissociation with molecular beams. Other theoretical work has dealt with flow of a conducting fluid past a magnetic source, propagation of solar protons in the interplanetary magnetic field, and radiative cooling of stellar material. A relatively inexpensive and simple system for displaying cloud photographs taken by the weather satellites ESSA II and Nimbus C was developed. The system utilizes an oscilloscope and Polaroid camera, rather than an expensive facsimile recorder.

Author

N67-26507*# Ludwig-Maximilians-Universitat, Munich (West Germany).

ON THE INFLUENCE OF ATMOSPHERIC TRANSMISSION FUNCTIONS ON INFRARED MEASUREMENTS IN PLANETARY ATMOSPHERES, PART II Final Report

I. Tannhaeuser Jan. 1967 75 p refs

(Grant NSG-305)

(NASA-CR-84157) CFSTI: HC\$3.00/MF\$0.65 CSCL 03B

Various methods to represent atmospheric radiation spectra and discrepancies in the results are discussed. A comparison is made of present calculations in the 4.5 micron region, where the bands of CO₂, N₂O, and CO are overlapping. The difference of calculated equivalent temperatures of the outgoing radiation are seen to be higher than 8°K. Approximate calculations in the Nimbus I HRIR region (3.4 to 4.2 micron) show that the bands of CO₂ and N₂O can be responsible for observed discrepancies. These gases account for about 2°K of the equivalent temperature. Detailed results for clouds of various heights and emissivities are tabulated. Approximate calculations in the long wave length wing of the 6.3 micron H₂O-band show that the neglect of N₂O and CH₄ against the H₂O transmission may cause an error of about 9°K between 7.25 and 7.75 microns. A general method for the representation of atmospheric spectra is given, based on laboratory transmission functions. Its applicability to the 1306/1550 CH₄, 2563/2461 N₂O, 3020 CH₄, 2143 CO, 2224 N₂O-bands, and the 6.3 micron H₂O and 4.3 micron CO₂-bands is demonstrated.

Author

N67-26620*# Columbia Univ., New York. Columbia Radiation Lab.

RADIO AND X-RAY ASTRONOMY

In its Res. Invest. Directed Toward Extending the Useful Range of the Electromagnetic Spectrum 31 Oct. 1966 p 93-102 refs

Radio and X-ray astronomy research is briefly outlined under the trichotomy: X-ray telescope, X-ray polarization, and models of planetary atmospheres. Microwave absorption coefficients measured for mixtures of carbon dioxide with nitrogen and argon, and water

vapor with nitrogen were applied to an analysis of the observed microwave emission spectrum of Venus with regard to the composition and structure of its atmosphere. It is reported that from spectroscopic evidence, the only gases definitely identified in the Venus atmosphere are carbon dioxide and, in very small amounts, water vapor. A large-area X-ray collector is reported for flight in an Aerobee 150 sounding rocket. R.L.I.

N67-27042# RAND Corp., Santa Monica, Calif.

PLANETARY CONTAMINATION. II: SOVIET AND U.S. PRACTICES AND POLICIES

Bruce C. Murray, Philip K. Eckman (Calif. Inst. of Tech.), and Merton E. Davies Mar. 1967 25 p refs

(AD-648864) CFSTI: HC\$3.00/MF\$0.65

It was concluded that viable terrestrial micro-organisms which are transported to Mars inside solid components in sealed spaces have a low probability of being released to the surface or atmosphere, and if any are released they are not likely to infect the planet. TAB

N67-27295* National Biomedical Research Foundation, Silver Spring, Md.

THERMODYNAMIC EQUILIBRIUM IN PREBIOLOGICAL ATMOSPHERES OF C, H, O, N, P, S, AND Cl

M. O. Dayhoff, E. R. Lippincott, R. V. Eck, and G. Nagarajan

Washington, NASA, 1967 274 p refs

(Grant NSR-21-003-002; NGR-21-002-059; NGR-09-015-023)

(NASA-SP-3040) CFSTI: HC\$3.00/MF\$0.65 CSCL 07B

A computational system for the equilibrium of many compounds in an ideal gas mixture was developed in connection with the study of the thermodynamic equilibrium of prebiological atmospheres containing varying amounts of C, H, O, N, P, S, and Cl. An introduction to the methodology, the tables for the computer survey, and the mathematical models are presented. Appendixes deal with thermodynamic equilibria in planetary atmospheres, and relate thermodynamic equilibrium to the inorganic origin of organic compounds. M.W.R.

N67-27370*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MARTIAN IONOSPHERE: A COMPONENT DUE TO SOLAR PROTONS

Carl Sagan and Joseph Veverka Apr. 1967 14 p refs

(Grant NGR-09-015-023)

(NASA-CR-84411; Rept.-703-24) CFSTI: HC \$3.00/MF \$0.65 CSCL 20H

The small magnetic field strength observed by Mariner 4 near Mars suggests that protons from the solar wind may enter the Martian atmosphere and produce ionization in addition to that produced by ultraviolet light and X-rays. It is found that solar protons produce a thin ionized layer at a rate $\approx 3 \times 10^3 \text{ cm}^{-3} \text{ sec}^{-1}$ at a depth corresponding to the F₁ region in the terrestrial atmosphere. Unless the effective recombinative coefficient is very large ($> 10^{-5} \text{ cm}^3 \text{ sec}^{-1}$), or unusual diffusion effects are present, this layer should have been detected by Mariner 4, and therefore must be present in one of the observed ionized regions. Because of its very compact shape, the subsidiary maximum near 95 km discovered in the Mariner-4 occultation experiment may be the proton ionization peak. If so, the major 120-km maximum is an F₂ layer. Distinction between photon and proton ionization regions can be made by microwave occultation experiments aboard planetary orbiters. Author

N67-27533*# International Information, Inc., Philadelphia, Pa.

BEYOND THE DOOR IS AN UNKNOWN PLANET [ZADVER'YU-NEZNAKOMAYA PLANETA]

L. Repin May 1967 4 p Transl. into ENGLISH from Komosomol'skaya Pravda (USSR), 21 Jan. 1967 (Contract NASw-1499)

(NASA-TT-F-11062) CFSTI: HC \$3.00/MF \$0.65 CSCL 14B

This article discusses a special device capable of reproducing the environmental conditions of other planets. This planetary simulator, called "Photostat-1" is essentially a pressure chamber capable of modeling the atmospheric composition, pressure, and the daily variations of Mars and other planets. This facility is the first which is capable of stimulating the UV radiation on other planets. Special lighting fixtures can imitate the entire solar spectrum, including a wide range of UV rays and individual lines of the solar spectrum. Experiments with the "Photostat" indicate that various living creatures may be able to survive in a wide range of alien conditions. Author

N67-28001* California Univ., Berkeley.

UPPER LIMITS ON LIQUID WATER IN THE VENUS ATMOSPHERE

W. J. Welch and D. G. Rea [1966] 9 p refs

(Contract NASr-220; Grants NSG-101-61; NSF GA-527)

(NASA-CR-84601) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

A consequence of the discovery of HCl and HF in the atmosphere of Venus, namely, that there cannot be much liquid water in the Venus atmosphere due to the presence of HCl, is discussed. The statement is based on microwave observations of the planet. The HCl is highly soluble in water, and the resulting acid has a high DC conductivity. If there were much of this acid in the Venus atmosphere, the long wavelength radar signals would be strongly attenuated, whereas the radar signals appear to reach the planet's surface with little attenuation. An even smaller upper limit on the liquid water content of the Venus atmosphere is obtained by another less direct argument. The microwave emission spectrum of the planet resulting from a cool acid cloud above the warm surface is considered. S.P.

N67-28368* Cutler-Hammer, Inc., Deer Park, N. Y. **INVESTIGATION OF PLANETARY IONOSPHERES**

B. Mohr, Z. Poznanski, D. Luganski, G. Kraft, and S. H. Gross Washington, NASA, May 1967 205 p refs

(Contract NAS5-9108)

(NASA-CR-689) CFSTI: HC \$3.00 CSCL 03A

The feasibility of using radio-sounding techniques to investigate the ionospheric properties of the planets was studied. Principal concern was with overall systems evaluation, signal processing, and transmitter design for an advanced long-range sounder system. Sounding ranges of interest were from nearby to 40,000 km. Application of the new sounder system was made to typical planetary missions such as the Voyager-Mars Orbiter and the Mariner-Mars flyby spacecrafts. The signal-processing design study was based on a previous program, which concluded that digitized pulse-compression and integration techniques were the most desirable methods to be used in advancing the state of the art of ionospheric sounding. Investigations of these techniques and their applications to typical planetary sounding systems resulted in detailed examinations of circuits, components, and characteristics. The design effort was direct toward providing a sounding capability from extremely long ranges, as well as from nearby, over a wide band of frequencies. The transmitter design consisted mainly of breadboarding efforts to realize a wide-band untuned system entirely of solid-state components. The task also included a study of the design of matching networks for dipole antennas. Author

N67-28513# RAND Corp., Washington, D. C.

AERODYNAMIC ASPECTS OF FUTURE SPACE VEHICLES AND IMPLICATIONS FOR TESTING

F. S. Nyland Mar. 1967 21 p refs

(P-3559; AD-649512) CFSTI: HC \$3.00/MF \$0.65

The paper treats some of the technical characteristics of lifting spacecraft and considers some problems of testing. Some general observations about operating lifting spacecraft in the 'atmospheres' of other planets were included in the hope of stimulating thought and discussion of such future possibilities.

Author (TAB)

N67-28785* Pittsburgh Univ., Pa. Dept. of Physics.

THE PROBLEM OF USING MARINER IV IONOSPHERIC DENSITIES TO DEDUCE A MODEL OF THE MARTIAN ATMOSPHERIC STRUCTURE

T. M. Donahue 7 Apr. 1967 24 p refs Presented at the Conf. on the Atmospheres of Mars and Venus, Kitt Peak Natl. Lab., Feb. 1967

(Contract NASr-179)

(NASA-CR-84825; SRCC-41) CFSTI: HC \$3.00/MF \$0.65 CSCL 04A

An F₁ layer maximum would apparently occur fifteen kilometers too high in the Martian ionosphere even though the atmosphere were pure CO₂ in a model with high temperature mesopause and thermopause. It is pointed out, however, that a similar calculation of electron densities in the earth's ionosphere starting with a reasonable model for neutral structure and temperature would also disagree with the observed profile of electron density in the F₁ region. It is argued that where no ionospheric model based on unforced assumptions manifestly supports any atmospheric model it is unreasonable to rely on ionospheric properties to discriminate between models. Author

N67-28789* Astro Research Corp., Santa Barbara, Calif.

DESIGN CRITERIA FOR LIGHTLY LOADED INFLATED STRUCTURES IN A NEAR-PLANETARY ATMOSPHERE

Peter G. Niederer 16 Feb. 1967 69 p refs

(Contract NAS7-427)

(NASA-CR-84829; ARC-R-246) CSCL 20K

For inflating a lightly loaded membrane, the simplest solution is offered by carrying a pressurization medium directly within the structure. The difference of state of this medium between the packed condition at the launching site and the deployed condition in the operating environment is used to deploy the body and then to rigidize it. Two near-earth environments and one near Mars are chosen for closer investigation. An exact knowledge is required of the equilibrium temperature a body attains due to radiative sources in space. Temperature can be regulated by the appropriate choice of the solar absorptivity and emissivity of the body surface. Pressurization substances are examined and their abilities to develop a certain pressure by varying the quantity used to inflate a given volume are investigated. An analysis is made to minimize the weight of an inflated body for a given task. The theory is applied to the bracing system of an X-brace Stokes flow decelerator.

Author

N67-29983* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

THE ENVIRONMENT OF VENUS: A DISCUSSION OF ITS ATMOSPHERE AND SURFACE

Robert B. Owen, C. L. Hasseltine, William T. Roberts, George S. West, and Jeanette A. Scissum 1 May 1967 142 p refs

Supersedes NASA-TM-X-53327; see N65-35976

(NASA-TM-X-53497; NASA-TM-X-53327) CFSTI: \$3.00 CSCL 03B

Presented is a self-consistent model atmosphere for the planet Venus, with emphasis on parameters of general use in developing vehicle design criteria. Kern and Schilling's program for generation of atmospheric parameter values is coupled with the most recent estimates of surface conditions in order to derive the atmosphere environment at different altitudes. A range of initial values is used to produce a parametric band most representative of

actual conditions. Because of the extreme pressures and temperatures involved, it is felt that design for such an environment presents an engineering problem of the first magnitude. Author

N67-30624*# GCA Technology Div., GCA Corp., Bedford, Mass.
PLANETARY METEOROLOGY Final Report
 George Ohring, Wen Tang, and Joseph Mariano Mar. 1967
 73 p refs
 (Contract NASw-1227)
 (NASA-CR-85569; GCA-TR-67-5-N) CSCL 03B

In the first of two studies the seasonal and latitudinal variations of the average surface temperature and vertical profile of atmospheric temperature on Mars are computed using a thermal equilibrium model. The computed temperature profiles satisfy the following equilibrium conditions: (1) a balance at the top of the atmosphere between net incoming solar radiation and outgoing infrared radiation; (2) a balance at the surface between the net gain of heat by radiation and the loss of heat by convective transport into the atmosphere, the amount of convective loss being determined from the net integrated radiative cooling of the convective layer, i.e., the troposphere; and (3) the stratosphere is in radiative equilibrium. In the second study, two dynamic models simulating the Martian atmospheric circulation are constructed. Model I, based on terrestrial atmospheric circulation, is a vertically integrated model for computing meridional profiles of mean mid-atmospheric zonal wind and temperature for both northern and southern hemispheres of Mars during the two equinoxes and the two solstices. Model II, a more sophisticated two-level quasi-geostrophic numerical model, can be used for computing similar Martian temperature and wind characteristics. K.W.

N67-30793# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Institut.
METHODS TO CALCULATE THE INFRARED RADIATION FROM PLANETARY ATMOSPHERES [METHODE ZUR BERECHNUNG DER VON PLANETEN-ATMOSPHAEREN AUSGESANDTEN INFRAROTSTRAHLUNG]
 I. Tannhaeuser Feb. 1967 12 p refs
 (BMWF-FB-W-67-02)

The spectrum of the outgoing radiation in the region between 4 to 5 microns is given for different cloud heights. From this, the radiative effect of the atmospheric gases between the cloud level and the receiver can be deduced. The product functions corresponding to the weighting function are also shown; the former give a more realistic impression than the latter. In addition to being accurate and simple, the method is especially applicable to the inversion problem and for the atmospheres of other planets, since the parameters in the atmospheric transmission functions may be varied without expending much computing time. Author

N67-31108*# New Mexico State Univ., Las Cruces.
JUPITER'S RED SPOT IN 1965-66
 H. Gordon Solberg, Jr. [1967] 17 p refs
 (Grant NSG-142-61)
 (NASA-CR-85560; TN-701-67-14) CSCL 03B

The latitude and longitude of Jupiter's Red Spot were measured from photographic plates obtained between 1 July 1965 and 4 June 1966. The Red Spot increased irregularly in System II longitude from 24° in July 1965 to 28° in June 1966. The zenographic latitude of the Red Spot remained near its mean value of -22.3°. Numerous fluctuations in the position and dimensions of the Red Spot were noted, and evidence for a relationship between the Red Spot and rapidly moving features of the South Temperate Belt (STB) is cited. An oscillation in the longitude of the Red Spot with a period of 88±10 days may have been produced by rapidly moving dark spots on the north edge of the STB, which moved 360° in longitude with respect to the Red Spot in 91 days. Author

N67-31336* California Univ., Berkeley. Dept. of Chemistry.
INFRARED SPECTROMETER DEVELOPMENT FOR SPACE VEHICLE STUDY OF PLANETARY ATMOSPHERES Final Report
 George C. Pimentel Jun. 1967 116 p
 (Contract NASr-212)
 (NASA-CR-85797) CSCL 20F

A filter-wedge spectrometer concept was found to be feasible with resolution of 1% and scan times of a few seconds. Infrared spectra were recorded in the laboratory using a black body at dry ice temperature (195°K) as the radiation source at 2% resolution over the wavelength range of 6 to 15 microns in a 3-min scan time. This optical design has the advantages of low power, ruggedness, and light weight. Laboratory research was performed to permit the design of an instrument suited to the Mariner spacecraft; and a ground-based model was also developed for balloon or ground-based telescopic study of the terrestrial and planetary atmospheres. This adaptation is useable for Mars and Venus studies in the 12 micron spectral region. M.W.R.

N67-32308*# Volt Technical Corp., Washington, D. C.
SOMETHING NEW ABOUT VENUS [NOVOYE O VENERE]
 D. Martynov 22 Jun. 1967 4 p Transl. into ENGLISH from Pravda (Moscow), no. 165, 1967
 (Contract NAS5-12487)
 (NASA-CR-86635; ST-PR-LPS-10628) CFSTI: HC \$3.00/MF \$0.65 CSCL 22A

A general discussion of the planet Venus is presented in terms of atmosphere, temperature measurements, cloud cover, and length of day. Implications of the high temperatures of Venus are noted; and mention is made of the Soviet cosmic rocket, Venus-4, launched June 12, 1967. M.W.R.

N67-32463# RAND Corp., Santa Monica, Calif.
CHANDRASEKHAR'S PLANETARY PROBLEM WITH INTERNAL SOURCES
 R. Bellman, H. Kagiwada, R. Kalaba, and S. Ueno May 1967 24 p refs
 (Contract F44620-67-C-0045; Proj. RAND)
 (RM-5229-PR; AD-652832) CFSTI: HC \$3.00/MF \$0.65

Invariant imbedding equations are developed for the determination of the vertical stratification of terrestrial and other planetary atmospheres on the basis of satellite observations. The top altitude of a cloud, for example, can be estimated from the relative spectral intensities of the solar radiation reflected from the cloud in the oxygen A band at 7600 angstrom, and in a nearby window. The results of RM-5245-PR are extended to solve the Chandrasekhar planetary problem for atmospheres with or without internal energy sources, and with or without bottom surface reflectivity, either Lambert or nonorthotropic. The differential-integral equations may be approximated by systems of stable initial-value problems that are readily and accurately solved by digital computers. TAB

N67-32494*# RAND Corp., Santa Monica, Calif.
SOME ASPECTS OF THE CIRCULATION OF MARS
 Conway Leovy Nov. 1965 27 p refs Presented at Conf. on Exploration of the Planets, Blacksburg, Va., 16-20 Aug. 1965
 (Contract NASr-21(07))
 (NASA-CR-86912; P-3262) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

Estimates of the vertical temperature structure and heat balance of Mars are reviewed and compared with the corresponding quantities on the Earth. The probable resulting circulation is discussed, and reasons for expecting a stronger solstice circulation on Mars than on the Earth are given. The problem of thermally driven tides is reviewed. The amplitude of such tides is likely to be small. Author

N67-32719* Avco Corp., Lowell, Mass.

A FEASIBILITY STUDY OF AN EXPERIMENT FOR DETERMINING THE PROPERTIES OF THE MARS ATMOSPHERE. VOLUME I: SUMMARY

Steven Georgiev Washington, NASA, Jul. 1967 141 p refs
(Contract NAS2-2970)

* (NASA-CR-530) CFSTI: \$3.00 CSCL 03B

A feasibility study of a Mars probe for obtaining vertical profiles of pressure, temperature, and density is reported. The most important mission objectives and constraints are summarized. The launch-to-probe/spacecraft separation, probe/spacecraft separation, and probe entry sequences are outlined. The overall probe system is described, and details are given on the entry probe, sterilization canister, probe-spacecraft integration, and the probe, separation, stabilization, and propulsion subsystem. Alternate mission modes and earth entry test program are also covered. It is felt that the engineering feasibility is established and the preliminary design satisfactory. N.E.N.

N67-32849* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INVERSE PROBLEMS IN RADIATIVE TRANSFER: A REVIEW

Barney J. Conrath Feb. 1967 35 p refs
(NASA-TM-X-55857; X-622-67-57) CFSTI: HC \$3.00/MF \$0.65 CSCL 20M

An elementary introduction to the inverse problem of radiative transfer as applied to remote measurements of infrared radiation from planetary atmospheres is presented, along with a review of work which has been done on the problem. Particular attention is given to the problems of inferring vertical temperature profiles and water vapor distributions in the earth's atmosphere. The principle methods which have been developed for solving these problems are discussed briefly. Examples of applications of temperature and water vapor inversions to both synthetic data and data taken with an IRIS instrument at balloon altitudes are presented.

N67-32936* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THEORETICAL COMPUTATIONS OF THE OUTGOING INFRARED RADIANCE FROM A PLANETARY ATMOSPHERE

Virgil G. Kunde Washington, NASA, Aug. 1967 121 p refs
(NASA-TN-D-4045) CFSTI: \$3.00 CSCL 03B

The solution to the radiative transfer equation for a non-gray absorbing atmosphere in local thermodynamic equilibrium was programmed for an IBM 7094 computer to calculate theoretically the outgoing infrared radiance in five wave number spectral intervals. The spectral range covered is from 5 to 20 microns. The theoretical outgoing radiances may be utilized in several ways: (1) to assist in selection of the desired spectral characteristics for infrared satellite experiments, (2) to test the validity of balloon and satellite observations, and (3) to aid in the analysis of planetary infrared radiation data. Theoretical thermal emission spectra were computed for several representative model atmospheres for Earth and Mars. These spectra illustrate that a considerable amount of information is available from radiation data of five wave number resolution. This information allows the recovery of the atmospheric and surface parameters from measured thermal emission spectra. Author

N67-32966* RAND Corp., Santa Monica, Calif.

GLOBAL RADIATION EMERGING FROM A RAYLEIGH SCATTERING ATMOSPHERE OF LARGE OPTICAL THICKNESS

Anne B. Kahle May 1967 29 p refs
(Contract F44620-67-C-0045)

(RM-5343-PR; AD-652648) CFSTI: HC \$3.00/MF \$0.65

Calculations of the total radiation emerging from planetary atmospheres optically thicker than those of the earth. For Rayleigh

scattering and Lambert reflectivity, the flux is determined for a wide range of solar elevations, ground reflectivities, and optical depths. For very large surface reflectivities there is more radiation downward onto a planet at the bottom of a thick atmosphere than is received at the top because the radiation that does penetrate undergoes multiple reflection. The total radiation absorbed by the surface plus the corresponding diffuse upward radiation always equals the input flow. Bond albedo is determined by numerical integration. It approaches the value of the ground reflectivity as optical thickness approaches zero, and approaches 1 as it becomes very large. Author (TAB)

N67-33596* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

OPTIMAL CONTROL THEORY

In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 8-28 refs

(Grant NGR-15-005-021; Contract JPL-950670)

Electric engineering developments in optimal control theory and information systems cover such topics as: error in linear systems with bounded input; control of systems with inaccessible states; time optimal feedback control; minimum sensitivity optimal control; stochastic cooperative games; pursuit problem applied to synthesis of stochastic optimal controller; specific soft-lander control problem; and maneuverable landing in Martian atmosphere. R.L.I.

N67-33758 Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.

DETERMINATION OF MARTIAN AND CYTHEREAN ATMOSPHERIC COMPOSITION WITH AN ENTRY PROBE BY MEASUREMENT OF ULTRAVIOLET AND X-RAY ATTENUATION

F. F. Fish and V. A. Sirounian April 1967 23 p refs
(DAC-60627)

Detailed is the manner in which Martian atmospheric composition and structure can be obtained applying the technique which focuses on the use of ultraviolet and absorption measurements from an entry probe or flyby. Also discussed is the applicability of the technique to studies of the Cytherean atmosphere. S.C.W.

N67-34135 General Electric Co., Philadelphia, Pa. Missile and Space Div.

TABLES OF THERMODYNAMIC PROPERTIES OF MARS ATMOSPHERES FOR CALCULATING EQUILIBRIUM FLOW FIELDS, PART I

C. L. Kyriss and A. Milas 12 Dec. 1966 35 p refs
(ATDM-66-1)

Thermodynamic data for three Martian model atmospheres have been processed for use in the GE-RSD flow field system for real gases in chemical equilibrium. The results of this work are reported in three parts. Part I treats the model composition: 4.9% CO₂-95.1% N₂ by volume, over the temperature range 90°R to 27,000°R and log₁₀ p/p₀ range -7.0 to 1.0. Part II treats the model composition: 9% CO₂-90% N₂-1% A by volume, over the temperature range 90°R to 27,000°R and log₁₀ p/p₀ range -7.0 to 1.8. And Part III treats the model composition: 48.8% CO₂-51.2% N₂ by volume, over the temperature range 90°R to 17,100°K and log₁₀ p/p₀ range -7.0 to 1.0. Author

N67-34596* Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

DUST PARTICLE TERMINAL VELOCITIES IN VENUS ATMOSPHERE FROM 0 TO 100 KILOMETERS

Albert D. Anderson May 1967 18 p refs
(LMSC-6-77-67-18)

In order to better understand the possible generation, persistence, and particle size range of dust in the Venus atmosphere, terminal velocities are calculated for spherical particles with diameters from one to 10,000 microns for three model atmospheres over the altitude range 0 to 100 km. The model atmospheres are based on minimum (30 atm; 620°K), most probable (50 atm; 688°K), and maximum (300 atm; 720°K) surface pressures and temperatures. Assuming a solid surface and the availability of dust on the ground, the following conclusions are reached: (1) The falling rates for the smaller dust particles (less than 50 microns) show the least sensitivity to the model used at the lower altitudes (less than 40 km) and the greatest sensitivity at the higher altitudes (90–100 km); (2) For all sizes considered, the vertical winds required to maintain particles aloft in the lower Venus atmosphere are less than one-half those needed on earth. Therefore, for the same degree of convective activity, one should expect more dust, consisting of larger particles ranging in size up to several hundreds of microns in diameter; (3) If, as is probable, Venus has much more convective activity than earth, then it is likely that a great deal more dust exists there, whose maximum size is on the order of one thousand microns in diameter. These last two conclusions lend support to Opik's Aeolosphere Model. Author

N67-34775*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
In its Space Programs Sum. No. 37–45, Vol. IV 30 Jun. 1967
p 235–243 refs

To provide an experimental basis for the geologic interpretation of spectral reflectance measurements of planetary surfaces, laboratory studies were made of particulate rocks. Changes in the wavelength distribution of reflected light were measured as functions of rock composition and mineralogy, particle size, particle shape, particle packing, and angle of illumination. Experimental results indicate that powdered silicate rocks can be classified as rock glasses, crystalline acidic rocks, or crystalline basic-ultrabasic rocks, on the basis of spectral reflectance in the 0.4 to 2.0 μ wavelength region. This led to the conclusion that a combination of several spectral reflectance properties is capable of giving some gross composition information on silicate rock powders. Summary data are provided on determinations of cloud-top pressure and hydrogen abundance in the Jupiter atmosphere. Also considered are four methods of analyzing the visible and near-infrared spectrum of solar energy returned from the lunar surface: photometry, polarimetry, luminescence, and spectrophotometry. Pictorial data are included to show the linear Martian features obtained from Mariner IV photographs. M.G.J.

N67-34884*# National Aeronautics and Space Administration,
Electronics Research Center, Cambridge, Mass.

FLYBY MEASUREMENTS OF THE PROFILES OF WATER VAPOR, PARTICULATE MATTER, AND CARBON DIOXIDE IN THE MARTIAN ATMOSPHERE

Alfred E. Barrington, Anthony J. Caruso, and Gene G. Mannella
Washington, NASA, Aug. 1967 16 p refs
(NASA-TN-D-4115) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

A study of infrared absorption measurements in the Martian atmosphere for the determination of the profiles of water vapor and carbon dioxide is presented in quantitative detail. Using the best available data on the Martian atmosphere, it is shown that with state-of-the-art instrumentation the following can be measured: an upper limit of water vapor of 10^{-3} g/cm²-column (at 6.3 μ), scattering by particulate matter (at 3.5 μ), and the carbon dioxide profile above an altitude of 50 km (at 4.3 μ). The choice of wavelengths and of experimental instrumentation is based on a realistic appreciation of Martian atmospheric characteristics and experience gained during the Mariner II Venus mission. Author

N67-35341# RAND Corp., Santa Monica, Calif.

THE TWILIGHT CUSP EXTENSION OF VENUS

G. F. Schilling and R. C. Moore Jun. 1967 11 p refs Submitted for publication
(P-3621; AD-654628)

It has been known since about 1790 that when Venus is near inferior conjunction, the cusps of her crescent extend far beyond a half-circle. It is further known that Venus, at greatest elongation, does not present the expected half-moon shape, but rather appears convex towards the illuminated side. This leads to a discrepancy of the order of days between date of apparent and geometric dichotomy, not satisfactorily explained to date. On the basis of our study, we are forced to infer that the scattering atmosphere of Venus extends to considerable heights above the cloud deck, and that its luminosity characteristics are not too far different from those of the earth's atmosphere. Height variations of the scattering atmosphere itself appear therefore to be immaterial, but small height variations of the probably uneven top of the opaque cloud deck would explain observed effects. TAB

N67-35919# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

SPACIAL AND TEMPORAL DISTRIBUTION OF THE GRADIENT RICHARDSON NUMBER IN THE SURFACE AND PLANETARY LAYERS

Frank V. Hansen May 1967 30 p refs
(ECOM-5123; AD-654993)

The Richardson number (Ri) as a function of height, time and stability classification method has been investigated by the use of wind and temperature profiles observed in the surface and planetary boundary layers. It was found that a reference height of three to six meters above the surface provides the best estimate of the Richardson number in respect to the energy balance of the air-earth interface. Further investigation revealed that nearly all boundary layer processes can be related to the Richardson number including a hypothesis in the form of wind and temperature profiles for a diabatic surface boundary layer. Author (TAB)

N67-37243# RAND Corp., Santa Monica, Calif.

THE TWILIGHT ATMOSPHERE OF VENUS

G. F. Schilling and R. C. Moore Jul. 1967 97 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5386-PR; AD-656307)

An investigation of the discrepancies between the theoretically predicted and the actually observed shape and periodic appearance of Venus. Current astronomical methods of observation of the twilight sky of Venus are investigated by combining a rigorous celestial geometry with a determination of the physical effects exerted by the relative luminances of the atmospheres of Venus and the Earth. Analysis shows that the discrepancy between the expected and observed times of dichotomy corresponds to a range in position angle from about 92 to 98 degrees, which implies a minimum height of the effectively scattering atmosphere from 13 to 23 km. There are indications that the true height may be several tens of kilometers. TAB

N67-38348*# Volt Technical Corp., Washington, D. C.

A TWO-LAYER MODEL OF VENUS ATMOSPHERE (INTERPRETATIONS OF RADAR OBSERVATIONS) [DVUSKHSLOYNAYA MODEL' ATMOSFERY VENERY (OB INTERPRETATSII RADIOLOKATSIONNYKH NABLYUDENIY)]

Y. N. Vetukhnovskaya and A. D. Kuz'min 10 Oct. 1967 6 p
Transl. into ENGLISH from Astron. Vestn. (USSR), v. 1, no. 2 p 85–88

(Contract NAS5-12487)

(NASA-CR-88980; ST-LPS-RA-10654) CFSTI: HC \$3.00/MF \$0.65 CSCL 03B

A two-layer model atmosphere of Venus is considered. It satisfies the data of both the radioastronomic and radar measurements, including the measurements at 3 cm. It shows a considerable decrease of the effective cross-section of Venus' reflection at short wavelengths. The first upper absorbing layer, being "cold", determines the spectrum of its proper radiation, but is transparent for the radiation with wavelength $\lambda > 3$ cm. This is why it does not affect the results of radar observations. The second absorbing layer, being near the planet's surface, and therefore "hot", absorbs the centimeter radiation and determines the frequency dependence of the effective Venus' reflection but does not influence the brightness temperature of the planet, for the temperature of this layer is similar to that of planet's surface. A surface absorbing layer may be a lower row of clouds, containing $(1 \pm 2) \cdot 10^3$ g/cm² of dust or about 2 g/cm² of polar liquid with equipartition time of $(1 \pm 2) \cdot 10^{-11}$ sec. Author

N67-39458# Ohio State Univ., Columbus. Aeronautical and Astronautical Research Lab.

CHEMICAL KINETICS OF ENTRY INTO THE MARTIAN ATMOSPHERE Final Report

E. Stokes Fishburne, K. R. Bilwakesh, and Rudolph Edse Wright-Patterson AFB, Ohio, ARL, May 1967 47 p refs (Contract AF 33(657)-8951) (ARL-67-0113; TR-6; AD-657778)

The reactions between carbon monoxide and oxygen to form carbon dioxide have been examined in two separate experimental studies. In the first study a mixture of carbon monoxide and oxygen was introduced into a shock tube. The mixture then was heated by a shock wave and the rate of formation of carbon dioxide was determined. The carbon dioxide concentration was followed by observing the intensity of the infrared radiation at 4.25 μ emitted by the heated carbon dioxide. Rate constants were obtained. However, it was shown that if the amount of water vapor in the system was greater than 7 ppm the primary reactions were governed by the hydrogen-oxygen system of reactions. Hence, it was impossible to obtain reliable rate constants for the CO-O₂ system of reactions. The elimination of such minute quantities of moisture is almost impossible. The second experimental study involved expanding a high temperature mixture of CO₂, CO, O, and O₂ through a supersonic expansion nozzle. From a measurement of the pressure profile down the nozzle the chemical state of the gas can be determined. Extensive computer programs were formulated for this phase of the investigation. Unfortunately the contract period came to an end at the conclusion of the calibration experiments. Hence, no information was obtained concerning the recombination of carbon dioxide. TAB

N67-39518# RAND Corp., Santa Monica, Calif.
LIFE IN THE UNIVERSE

S. H. Dole Sep. 1967 21 p Presented at Hawthorne School, Beverly Hills, Calif., 28 Jul. 1967 (P-3669; AD-658009)

If life will appear whenever the conditions are tolerable, as stated by many modern scientists, and if there are numerous planets in the right mass range orbiting at the proper distance around suitable stars, then life must be quite common. Assuming here that the word life, wherever it appears, implies life based on water and on carbon compounds, that is, life as-we-know-it and as found on the surface of the earth. There are some very good arguments in support of this. Another argument depends on the very unusual properties of water and of the compounds of carbon. Water is an amazing material--there is no other compound that comes close to it in many of its properties. Similarly, no other element but carbon has the property of being able to form such an enormous variety of complicated long-chain compounds--as are demanded by life processes. Something like half-a-million compounds of carbon have been identified--which is perhaps 50 times as many as all the chemical compounds that do not contain carbon. TAB

N67-40004* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

STUDY OF DUST DEVILS IN RELATION TO THE MARTIAN YELLOW CLOUDS Quarterly Progress Report, 1 Jun.-31 Aug. 1967

J. A. Ryan and F. F. Fish, Jr. 31 Aug. 1967 116 p refs (Contract NASw-1670) (NASA-CR-89578; QPR-1) CSCL 03B

A study is being conducted to determine whether dust devils could occur on Mars and be responsible for the observed yellow clouds. Emphasis is being given to field studies and during this period field data were obtained in the Mojave Desert of Southern California. Quantities measured were temperature as a function of height and time, background wind velocity, wind direction, pressure, dust devil diameter, dust column height, height of dust devil associated turbulence, and horizontal wind velocity inside the dust devil. Temperature measurements were initially taken up to 150 meters, but on occasion the temperature lapse rate remained superadiabatic above this height. Accordingly, measurements were extended up to 1540 meters above the surface using a light plane. The maximum dust devil velocity recorded to date was 45 km/hr under strongly superadiabatic conditions. Dust devil associated turbulence was found as high as 3600 meters above the surface and the maximum dust column height was 450 meters. The data demonstrate that a superadiabatic lapse rate is necessary for dust devil generation and their considerable vertical extent. Author

N67-40462*# Stanford Univ., Calif.

RELATIONSHIP OF PLANETARY QUARANTINE TO BIOLOGICAL SEARCH STRATEGY

E. C. Levinthal, J. Lederberg, and Carl Sagan (Harvard Univ., Cambridge, Mass.) [1967] 15 p refs (Grant NsG-81) (NASA-CR-89772) CFSTI: \$3.00 CSCL 22A

Decision theory search strategies are discussed for Mars missions, emphasizing planetary quarantine considerations. In addition to the detection and characterization of life on Mars, attention is directed to the importance in mission decision analysis of judging the future utility of Mars and the possibilities of modifying Mars atmosphere, and of arriving at an explicit statement of the probabilities of back contamination of the Earth. A method of analysis used in a pilot problem of a simplified version of the decision required in selecting Voyager-Mars mission configurations is also examined. E.C.

1966

IAA ABSTRACTS

A66-25169 #

EQUILIBRIUM AND NON-EQUILIBRIUM RADIATION IN SIMULATED PLANETARY ATMOSPHERES.

J. S. Gruszczynski and K. M. Thomas (General Electric Co., Missile and Space Div., Space Sciences Laboratory, Valley Forge, Pa.). American Institute of Aeronautics and Astronautics, Plasmadynamics Conference, Monterey, Calif., Mar. 2-4, 1966, Paper 66-183, 45 p. 15 refs.

Members, \$0.75; nonmembers, \$1.50.

Contract No. JPL-950297.

Discussion of experimental data of high-temperature gas radiance obtained in several gas mixtures containing CO₂, N₂ and Ar. It was found that the presence of relatively large amounts of argon (30%) has a strong influence on the equilibrium radiative properties of the gas. This appears as a large increase of radiance for stagnation conditions corresponding to flight velocities above 27,000 fps. At a velocity of 30,000 fps, the gas mixture containing 30% argon exhibits radiance which exceeds the radiance of the argon-free gas by a factor of 8. This difference diminishes at higher velocities. It is noted that the theoretical prediction of the radiative properties for the 9% CO₂ - 91% N₂ gas underestimates considerably the measured radiance for this gas. At the velocity of 30,000 fps, the measured values are higher than calculated by a factor of approximately 4. It is suggested that the contribution of the CN radical may be larger than calculated. M. M.

A66-25235 #

RADIO OCCULTATION INVESTIGATIONS OF THE ATMOSPHERE OF MARS.

Arvydas Kliore and Dennis A. Tito (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 5-13. 9 refs.

Description of a means for investigating the atmosphere and ionosphere of Mars by measuring the effects of their refraction on the frequency, phase, and amplitude of a signal received from a space probe before and after occultation by the planet. Such measurements with an occulting orbiter would yield improved determinations of the shape of the planet and density profile of the lower atmosphere, as well as the electron density profile of the ionosphere over a large number of locations on the planet's surface, thus providing information on diurnal, seasonal, and latitudinal variations. Simulations of some typical 1971 orbits are discussed. R. A. F.

A66-25272 #

SOME CONSIDERATIONS FOR MANNED MARS ENTRY AND LANDING.

M. G. Boobar (North American Aviation, Inc., Space and Information Systems Div. and Advanced Systems Div., Downey, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 357-362. 8 refs.

Contract No. NAS 2-2477.

Consideration of certain factors involved in the entry and landing phases of a manned mission to Mars. The applicability of retropropulsion and aerobraking modes during these phases is compared, and it is concluded that weight tradeoffs favor aerobraking. The effect of present uncertainties in the atmospheric characteristics

on the feasibility of performing the aerobraking maneuver and a number of functional requirements are considered in the light of the Mariner 4 atmospheres, as well as a number of other model atmospheres that have been postulated. Although the most recently reported low-density atmospheres have served to further constrain the available entry window, aerobraking is still thought to be feasible. A. B. K.

A66-25273 #

SOME REQUIREMENTS ON LIFTING VEHICLES FOR MANNED MARS OPERATIONS.

B. L. Swenson, R. W. Carlson, and E. L. Tindle (NASA, Office of Advanced Research and Technology, Mission Analysis Div., Moffett Field, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 363-369. 16 refs.

Examination of some of the operational problems peculiar to a manned Mars landing mission, with particular attention to the determination of quantitative requirements for lift associated with advanced vehicles used during such missions. The aerodynamic requirements are given for manned atmosphere capture at Mars for the current low-density atmosphere models. Aerodynamic requirements are also indicated for the lateral ranging required to achieve certain landing sites within overall mission constraints. Results are given for the lifting requirements on the manned landing vehicle for parachute deployment during terminal descent in the tenuous Martian atmosphere. It is shown that surface launch windows may be broadened through the use of lift during the ascent phase of the mission. R. A. F.

A66-25274 #

LAMINAR CONVECTIVE HEATING AND ABLATION IN THE MARS ATMOSPHERE.

Joseph G. Marvin and Ronald B. Pope (NASA, Ames Research Center, Moffett Field, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 370-382. 37 refs.

The influence of atmospheric composition on heat transfer and ablation is investigated. Equilibrium convective heating, including boundary-layer mass addition, is studied analytically. It is illustrated that the gas properties at relatively low temperatures near the wall control the heating rate and that precise definition of transport properties at the stagnation temperatures associated with entry is not necessary. A correlation equation, in terms of the relatively low-temperature free-stream gas properties and a suitably defined mass-addition parameter, is given. Heating rates for no mass addition in representative Martian atmospheres are from 10 to 25% higher than those in nitrogen. Experimental heat transfer to nonablating and ablating model surfaces is presented. Data in nitrogen and argon streams compare adequately with the theory. For gas mixtures of nitrogen and carbon dioxide and of nitrogen and oxygen, the heat transfer to ablating surfaces is shown to increase as much as 25% as a result of combustion of ablation vapors.

(Author)

A66-25275 #

THEORETICAL INVESTIGATION OF THE STATIC AND DYNAMIC STABILITY OF ENTRY VEHICLES IN THE MARS ATMOSPHERE.

C. L. Kyriss and H. Rie (General Electric Co., Missile and Space Div., Re-Entry Systems Dept., Philadelphia, Pa.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 383-390. 8 refs.

Inviscid equilibrium gas stability characteristics for a number of pointed and spherically blunted bodies in unsteady supersonic flight in the NASA Mars atmospheres have been calculated, to determine the effect of atmospheric composition on vehicle stability. The computation is carried out in two parts. First, a complete solution of the steady state, zero angle of attack flow field in the shock layer is obtained for each model composition when treated as a real gas in chemical equilibrium. Then a perturbation method is employed to determine the unsteady supersonic flow field. Static and dynamic stability derivatives (as a function of center of gravity location) are presented at a typical flight condition in each of the Mars model compositions and in air for several vehicle shapes. In addition, the variation of stability characteristics at discrete points along an entry trajectory is presented for a 45° pointed cone. It is shown that, in general, stability characteristics are not strongly influenced by the atmosphere composition for the vehicle geometries, atmospheric compositions, and flight conditions investigated.

(Author)

A66-25276 #

THE QUALITATIVE BEHAVIOR AND EFFECTS OF NONEQUILIBRIUM CHEMISTRY BEHIND STRONG SHOCK WAVES IN GAS MIXTURES OF CO₂ AND N₂.

Robert L. McKenzie (NASA, Ames Research Center, Moffett Field, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 391-409. 24 refs.

A detailed estimate is made of the chemical system and its reaction rates for shock conditions typical of those during entry into the Martian atmosphere. The results are shown to represent qualitatively the postshock chemical behavior and are intended to serve as a basis for the design and analysis of related experimental investigations. They are subject, however, to substantial numerical adjustment as definitive experimental results become available. The variations in the gross thermodynamic properties and individual species concentrations behind normal shock waves are illustrated for shock speeds of 4 to 8 km/sec and ambient densities which bracket the range of aerodynamic interest during atmosphere entry. The species included are CO₂, N₂, CO, CN, NO, O₂, C, O, and N. A system of 17 reactions is studied initially, 9 of which are shown to control the gross thermochemical behavior. Particular emphasis is given to the production of the strong radiant emitter, CN. Comparisons are made with some preliminary experimental results and they demonstrate the ability of the proposed chemical system model to reasonably predict the apparent production rate of CN behind a normal shock wave. For most shock conditions anticipated during entry into the Martian atmosphere, the concentration of CN is shown to rapidly overshoot its equilibrium value in the flow behind normal shock waves. Similar results are obtained for the shock layer ahead of a typical blunt Mars atmosphere probe over the major portion of most entry trajectories.

(Author)

A66-25291 #

OUR PRESENT KNOWLEDGE OF THE MARTIAN ATMOSPHERE.

D. F. Spencer (California Institute of Technology, Jet Propulsion Laboratory, Engineering Mechanics Div., Pasadena, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 532-541. 22 refs.

Experimental data relating to the Martian surface pressure and surface density and the interpretation of the data required to obtain these physical properties are presented. The discussion of the ground-based astronomical data emphasizes the determination of the Martian surface pressure from carbon dioxide absorption

spectra. Variations in the determination of the total carbon dioxide abundance and total surface pressure between investigators are given. The author's preferred best-estimate of the Martian total surface pressure is 6 mb based on the 8700-Å data of Spinrad and Schorn and the 1.56-μ data of Kuiper and Owen. A limited discussion is presented on the Mariner 4 occultation data including potential error sources and limitations on data applicability. Finally, a comparison of the Mariner 4 and ground-based observational data is made, including that of possible error sources in the data as well as potential secular variations in the Martian surface pressure.

(Author)

A66-25292 #

DESIGN PROBLEMS AND EXPERIMENTS FOR MARS ATMOSPHERE PROBES.

David E. Reese, Jr. (NASA, Ames Research Center, Vehicle Environment Div., Moffett Field, Calif.) and Steven Georgiev (NASA, Ames Research Center, Moffett Field, Calif.; Avco Corp., Research and Advanced Development Div., Wilmington, Mass.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966. TECHNICAL PAPERS.

New York, American Institute of Aeronautics and Astronautics, 1966, p. 542-552. 7 refs.

Review of experiments with a probe for the investigation of the Martian atmosphere and a study of the design problems inherent in the construction of such probes. Methods by which the structure and composition of planetary atmospheres can be determined from measurements made on board an entry vehicle are discussed; the fundamental principle on which these methods are based is the correlation which exists between the density, pressure, and temperature profiles for varying altitudes and vehicle deceleration measurements during the high-speed portion of the entry. Optical and mass spectroscopic techniques are described for measuring atmospheric composition. Vehicle design problems are considered in terms of major vehicle subsystems including spin stabilization, instrumentation, heat shield, and electrical power.

D. P. F.

A66-25461

DETERMINATION OF THE LUMINANCE OF THE MARTIAN ATMOSPHERE [DETERMINATION DE LA LUMINANCE DE L'ATMOSPHERE DE LA PLANETE MARS].

Audouin Dollfus (Paris, Observatoire, Meudon, Seine-et-Oise, France).

Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques, vol. 262, no. 7, Feb. 14, 1966, p. 519-522. 14 refs. In French.

Updating of work estimating the quantity of light diffused by the Martian atmosphere. Measurements of the variation of the polarization of the light from Mars between the center and the edge of the disk give a value to the luminance of the atmosphere, in the absence of haze or clouds, of around 6.0×10^{-4} sb/phot. If the low surface pressure determined spectroscopically and by Mariner 4 (9 to 20 mb) is correct, then a small amount of a fine aerosol must be permanently suspended in order to give the measured values of luminance.

F. R. L.

A66-25834

MARTIAN ATMOSPHERE - THE MARINER OCCULTATION EXPERIMENT.

Joseph W. Chamberlain and Michael B. McElroy (Kitt Peak National Observatory, Space Div., Tucson, Ariz.).

Science, vol. 152, Apr. 1, 1966, p. 21-25. 35 refs.

Further analysis of data from the Mariner 4 occultation experiment. It is argued that the CO₂ in the Martian atmosphere is not strongly dissociated (as was earlier assumed) and that the main ionospheric peak is analogous to the terrestrial E or perhaps F1 region.

R. A. F.

A66-26031 #**RADIOASTRONOMY STUDIES OF VENUS AND MARS.**

Cornell H. Mayer (U.S. Naval Research Laboratory, Washington, D. C.).

Astronautics and Aeronautics, vol. 4, Apr. 1966, p. 13, 15, 16, 21, 23-25.

Review of radio astronomical studies of the planet Venus. The theoretical bases of such studies are outlined. Observations of Venus are recounted and the results summarized. Radio observations of Mars, which have been less extensive and less fruitful than those of Venus, are briefly considered. The future prospects of such observations of Mars and Venus are surveyed. R. A. F

A66-26122 #**LIMITATION ON OXYGEN CONCENTRATION IN A PRIMITIVE PLANETARY ATMOSPHERE.**

L. V. Berkner and L. C. Marshall (Southwest Center for Advanced Studies, Dallas, Tex.).

Journal of the Atmospheric Sciences, vol. 23, Mar. 1966, p. 133-143, 25 refs.

Research supported by the Southwest Center for Advanced Studies; NSF Grants No. GP-768; No. GP-4708.

The absorption of ultraviolet radiation across the dissociative band (1500-2100 Å) is computed for the three component atmospheric system, O₂, CO₂, H₂O, for a considerable range of possible primitive atmospheres. The results illustrate clearly the limitation on photodissociation of H₂O as a source of oxygen, as a consequence of shadowing of H₂O by the oxygen so produced. Thus the Urey self-regulation of the maximum oxygenic concentration in a primitive atmosphere (in the absence of appreciable photosynthetic oxygenic production) is shown as not exceeding about 10⁻³ of the present oxygenic concentration. The presence of excess carbon dioxide lowers this limit somewhat. These conclusions have important implications with respect to the limiting oxygenic content of the primitive atmosphere of any planet. (Author)

A66-26132 #**THE VERTICAL TEMPERATURE DISTRIBUTION IN THE MARTIAN ATMOSPHERE.**

George Ohring and Joseph Mariano (Geophysics Corporation of America, Bedford, Mass.).

Journal of the Atmospheric Sciences, vol. 23, Mar. 1966, p. 251-255, 8 refs.

Contract No. NAS 9-3423.

Review of previous calculations of the vertical temperature distribution in the Martian atmosphere, based upon a convective-radiative equilibrium model. Vertical temperature distributions computed for the Martian atmosphere indicate that the temperatures are not sensitive to variations in surface pressure and carbon dioxide comparable to present uncertainties in these parameters - a result also evident in the computations of Prabhakara and Hogan. Where comparisons could be made between the present results and those of Prabhakara and Hogan, they indicate that the computed temperature profiles are in good qualitative agreement but that the present profiles are some 15 to 20°K lower above 20 km. M. F.

A66-27278**DEVELOPMENTS IN MICRO GAS CHROMATOGRAPHY.**

W. F. Wilhite (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.).

Journal of Gas Chromatography, vol. 4, Feb. 1966, p. 47-50, 7 refs.

A micro gas chromatographic system has been developed at the Jet Propulsion Laboratory to analyze the atmosphere of Mars in a few seconds during the descent of a landing capsule. The system consists of micro components, including highly efficient micro packed columns capable of rapid separation at flow rates of less than 1 cc per minute, a micro thermal conductivity detector with an internal volume of 0.1 μliter and sensitivity better than 5 ppm and a sampling valve capable of injecting a 1-μliter gas sample. The components, and the new techniques required to develop them, are described. (Author)

A66-27432 #**CONVECTIVE HEAT TRANSFER IN PLANETARY GASES.**

Joseph G. Marvin and George S. Deiwert (NASA, Ames Research Center, Moffett Field, Calif.).

AIAA Journal, vol. 4, Apr. 1966, p. 727, 728, 6 refs.

Demonstration of the manner in which a versatile equation can be used to predict the heating rate in gas mixtures representative of planetary atmospheres. The advantage of this equation is that the transport properties of the gas at the typically high stagnation temperatures associated with entry velocities are eliminated and replaced by those at a relatively low temperature. The equation can be used for ionizing monatomic gases, dissociating gases, and combinations of these. M. M.

A66-27534 #**NATURAL OSCILLATIONS OF PLANETARY ATMOSPHERES AS A FUNCTION OF THE PLANET'S SPEED OF ROTATION**

[SOBISTVENNYE KOLEBANIYA PLANETNYKH ATMOSFER V ZAVISIMOSTI OT SKOROSTI VRASHCHENIYA PLANETY].

G. S. Golitsyn and L. A. Dikii (Akademiia Nauk SSSR, Institut Fiziki Atmosfery, Moscow, USSR).

Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana, vol. 2, Mar. 1966, p. 225-235, 13 refs. In Russian.

Numerical calculation of the periods of natural oscillation and the corresponding eigenfunctions for planetary atmospheres as a function of the parameter γ (square of the ratio of twice the linear velocity at the equator to the speed of sound). The results of the numerical integration of the Laplace tidal equations are found to correlate well with the asymptotic theories proposed by Hough and by Dikii, for small and large values of γ , respectively. The lower oscillation modes are calculated for the atmospheres of the earth and Jupiter. V. P.

A66-27874 #**EARTH ENTRY FLIGHT TEST OF MARS ENTRY VEHICLES.**

F. G. Beuf, G. D. Katz, and R. J. Kern (General Electric Co., Philadelphia, Pa.).

(American Institute of Aeronautics and Astronautics and NASA, Flight Testing Conference, Huntsville, Ala., Feb. 15-17, 1965, Paper 65-219.)

Journal of Spacecraft and Rockets, vol. 3, Apr. 1966, p. 498-503.

A66-27875 #**EARTH RE-ENTRY SIMULATION OF PLANETARY ENTRY ENVIRONMENT.**

Haim Kennet (Boeing Co., Aero-Space Div., Flight Technology Dept., Seattle, Wash.) and Roy A. Taylor (Boeing Co., Aero-Space Div., Seattle, Wash.).

(American Institute of Aeronautics and Astronautics and NASA, Flight Testing Conference, Huntsville, Ala., Feb. 15-17, 1965, Paper 65-218.)

Journal of Spacecraft and Rockets, vol. 3, Apr. 1966, p. 504-512, 11 refs.

A66-27887 #**BUOYANT PROBES INTO THE VENUS ATMOSPHERE.**

F. R. Gross (Goodyear Aerospace Corp., Space Systems Div., Akron, Ohio).

(AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, UNMANNED SPACECRAFT MEETING, LOS ANGELES, CALIF., MARCH 1-4, 1965 /AIAA Publication CP-12/, p. 76-87.)

Journal of Spacecraft and Rockets, vol. 3, Apr. 1966, p. 582-587, 17 refs.

A66-28129

A NEW ESTIMATE OF THE SURFACE TEMPERATURES OF VENUS.
William Plummer and John Strong (Johns Hopkins University, School of Engineering Science, Laboratory of Astrophysics and Physical Meteorology, Baltimore, Md.).
Astrophysical Journal, vol. 144, Apr. 1966, p. 422-424. 15 refs.
Contract No. AF 19(628)-4334.

Comments on recent measurements of the surface temperature of Venus. It is shown that the polarization measurements by Clark and Kuz'min may be used with the radar dielectric coefficient to estimate what part of the total microwave brightness is due to thermal radiation from the surface of Venus, as distinguished from nonthermal emission originating in the Venus atmosphere. It is concluded that all microwave temperature measurements reported prior to those of Clark and Kuz'min have been based upon an oversimplified model which failed to provide for nonthermal emission.

A. B. K.

A66-29417

UPPER ATMOSPHERE AND IONOSPHERE OF MARS.

T. M. Donahue (Pittsburgh, University, Pittsburgh, Pa.).
Science, vol. 152, May 6, 1966, p. 763, 764. 6 refs.
NSF-supported research; Contract No. NASr-179.

It is argued that the single-layer ionosphere at 125 km discovered in the Mariner 4 occultation experiment is an F1 region coinciding with the UV photoionization peak. The CO₂ density there must be of the order of 10¹¹ molecules/cm³. Such a density is consistent with the properties of the lower atmosphere by Mariner 4 and the temperature model of Chamberlain and McElroy if the atmosphere is mainly CO₂ below 70 km. The absence of an F2 region can be explained even if the density ratio of O to CO₂ is 100 at 230 km on the basis of the rapid conversion of O⁺ to O₂ by CO₂. Thus a model with an exospheric temperature of 400°K, a modest degree of CO₂ dissociation, and diffusive separation above 70 km is possible.

(Author)

A66-29643

PURITY OF THE MARTIAN ATMOSPHERE [SUR LA PURETE DE L'ATMOSPHERE DE LA PLANETE MARS].

Audouin Dollfus and Jean Focas (Paris, Observatoire, Meudon, Seine-et-Oise, France).

Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques, vol. 262, no. 15, Apr. 13, 1966, p. 1024-1027. In French.

Study of the spectral variation in the polarization of light from the planet Mars, over all of the observable phase angles and for eight ranges of spectra covering 0.47 to 1.05 μ , during the period Dec. 1964 to July 1965. The curves for the variation of the proportion of polarized light are plotted as a function of the phase angle using different filters and only retaining data recorded in the absence of observable clouds in the Martian atmosphere. The degree of polarization at the center of the disk for the maximum phase angle of 39.9° is plotted as a function of the day and month of the year. It is found that pulverized samples of limonite and goethite reproduce the characteristics of the polarized light received from Mars with close accuracy. This would appear to demonstrate that the estimate of 30 mb for the Martian atmospheric pressure is too high. D.P.F.

A66-29951 #

AN ANALYSIS OF MARTIAN CLOUDS AND THEIR TOPOGRAPHICAL RELATIONSHIP.

R. A. Wells (London, University, University College, London, England).

COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper. 59 p. 58 refs.

Study of Martian clouds and of their relationships from tabulated data representing occurrences over the past century. The frequency of cloud occurrences distributed against heliocentric longitude is displayed in histogram form for the two chief cloud groups, white and yellow. White clouds show two peaks of maximum occurrence, while yellow clouds appear to show three peaks. The white cloud histogram is a map of water vapor transfer from the polar caps to the equatorial region. The yellow cloud frequency follows a general increase in the amount of insolation received by the planet. Areographic latitude plots of white and yellow cloud positions against

heliocentric longitude reveal that the darkening wave is due to the transport of both water vapor and dust from high latitudes toward the equator.

M. M.

A66-29952 #

ROTATIONAL EFFECTS IN THE MAGNETOSPHERE OF JUPITER.

D. B. Melrose (Sussex, University, School of Mathematical and Physical Sciences, Falmer, Brighton, England).

COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper. 11 p. 7 refs.

Discussion of the major formal difficulty encountered in trying to construct a theoretical model magnetosphere for the planet Jupiter constituted by the consequences of the rapid rotation of the planet on the distribution of plasma in the magnetosphere. It is pointed out that, for the magnetosphere of Jupiter, rotational effects are important beyond a few radii, and, consequently, some additional physical condition (other than interparticle collisions) must determine the plasma distribution at such distances. It is suggested that the appropriate condition is that the magnetosphere be stable against fluting (interchanges of the flux tubes of the magnetic field) when this can reduce the total kinetic energy of rotation of the magnetosphere. It is also suggested that the onset of the two-stream instability causes the corotating magnetosphere to break down at distances well inside distances where the solar wind would give a boundary similar to that of the magnetosphere of the earth. M. M.

A66-29958 #

RADIO OCCULTATION MEASUREMENT OF THE MARTIAN ATMOSPHERE OVER TWO REGIONS BY THE MARINER IV SPACE PROBE.

Arvydas Kliore, Dan L. Cain, and Gerald S. Levy (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper. 18 p. 12 refs.

During the July 1965 fly-by of Mars by the Mariner 4 space probe, radio occultation measurements of the atmosphere were performed over two regions above the planet's surface. Preliminary analysis of the data obtained during the exit phase, which occurred on the dark side over Mare Acidalius, indicates that the surface pressure there is some 3 mb higher than that over the entry region (Electris/Mare Chronium). In addition, analysis of the trajectory of the probe at the times of commencement and end of occultation indicates that the surface feature which interrupted the signal of the probe at commencement of occultation was at a radial distance of about 3384 \pm 3 km from the mass center of Mars, and the corresponding radial distance at exit was about 3379 \pm 4 km.

(Author)

A66-29966 #

A DISCUSSION OF THE PLANETARY QUARANTINE CONSTRAINTS.

J. O. Light, C. W. Craven (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), W. Vishniac (Rochester, University, Rochester, N.Y.), and L. B. Hall (NASA, Washington, D.C.).

COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper. 16 p.

Demonstration of the incompleteness of the current standards for planetary quarantine because they do not consider all of the numerous sources of potential biological contamination. It is also shown that the allocation process necessary to distribute the total probability of contamination to each of these numerous and complex sources of contamination will be a prodigious and detailed task. The following statement of the appropriate level of commitment is recommended: the planetary quarantine policy shall require 99.9% confidence that the unmanned exploration of Mars will not contaminate the planet with terrestrial organisms. A partial list and discussion of the numerous sources of contamination which must be considered by the set of planetary quarantine constraints is provided.

M. M.

A66-30049 #**THE ATMOSPHERIC PRESSURE AT THE SURFACE OF MARS.**

Karl D. Rakos (Graz, University, Observatory, Kanzelhöhe, Austria; Lowell Observatory, Flagstaff, Ariz.).

COSPAR, International Space Science Symposium, 7th, Vienna, May 10-19, 1966, Paper. 4 p.

NASA-supported research.

Experimental results on the determination of the density of the Martian atmosphere from photoelectric measurements of the eclipses of Phobos using a newly developed photoelectric scanner, the 61-in. reflector at Flagstaff, Ariz. in January and June 1965, and the 84-in. telescope at Kitt Peak, Ariz. in June 1965. The first useful and best observation was obtained on Jan. 11; the June observations are not very suitable as in that month Phobos was 0.7 magnitude fainter than in January. The May 1967 eclipses will be more propitious due to the fact that Phobos will be nearly two magnitudes brighter than in January. The surface pressure was found to be 30 mb; the observed light curve was brought into very good agreement with the computed values by successive approximations.

D. P. F.

A66-30050 #**A THEORETICAL INVESTIGATION OF CYTHEREAN, MARTIAN AND JOVIAN UPPER ATMOSPHERES.**

Mikio Shimizu (Ochanomizu University, Dept. of Physics, Tokyo, Japan).

COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper. 4 p. 7 refs.

Calculation of the heights of the dissociation layers on Venus, Mars, and Jupiter using the atmospheric model proposed by Kaplan, Kliore, and others. The results are summarized in a table together with the intensities of the CO flame airglow estimated from these data. The effect of diffusion was neglected, and a technique is given for including this parameter.

D. P. F.

A66-30352 #**BALLOON-TELESCOPE OBSERVATION OF THE PLANETS.**

John D. Strong (Johns Hopkins University, Baltimore, Md.).

IN: VIRGINIA POLYTECHNIC INSTITUTE, CONFERENCE ON THE EXPLORATION OF MARS AND VENUS, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA., AUGUST 23-27, 1965, PROCEEDINGS. [A66-30350 16-30]

Conference supported by the National Aeronautics and Space Administration, and the U. S. Air Force Cambridge Research Laboratories.

Blacksburg, Va., Virginia Polytechnic Institute, 1965, p. II-1 to II-8, 18 refs.

Determination of water vapor in the upper atmosphere of Venus with an automatic telescope-spectrometer unit carried by a balloon. Certain aspects of the data-recording system are discussed, as well as the method of data reduction. The results of absorption measurements are interpreted in terms of water-vapor quantities on Venus. A mechanism by which the cloud temperature on the dark side of Venus is prevented from falling below -40°C is suggested. A. B. K.

A66-30353 #**SOME ASPECTS OF THE CIRCULATION OF MARS.**

Conway Leory (RAND Corp., Santa Monica, Calif.).

IN: VIRGINIA POLYTECHNIC INSTITUTE, CONFERENCE ON THE EXPLORATION OF MARS AND VENUS, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA., AUGUST 23-27, 1965, PROCEEDINGS.

Conference supported by the National Aeronautics and Space Administration, and the U.S. Air Force Cambridge Research Laboratories.

Blacksburg, Va., Virginia Polytechnic Institute, 1965, p. III-1 to III-10. 20 refs.

Contract No. Nasr-21(7).

Study of the circulation of the Martian atmosphere and of its implications for terrestrial meteorology. Some of the main features of the expected vertical temperature distribution, as given by radiative-equilibrium calculations, are reviewed. Estimates are

made of the diurnal component of the small-scale vertical heat flux and of the amplitude of the thermal tides that this diurnally varying heat input would produce. A study is made of differential heating and general circulation at the solstices.

A. B. K.

A66-30355 #**THE SYSTEMATIC INVESTIGATION OF THE METEOROLOGY OF MARS.**

Morris Tepper (NASA, Office of Space Science and Applications, Washington, D.C.).

IN: VIRGINIA POLYTECHNIC INSTITUTE, CONFERENCE ON THE EXPLORATION OF MARS AND VENUS, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA., AUGUST 23-27, 1965, PROCEEDINGS.

Conference supported by the National Aeronautics and Space Administration, and the U.S. Air Force Cambridge Research Laboratories.

Blacksburg, Va., Virginia Polytechnic Institute, 1965, p. V-1 to V-14.

Study of the relationship of weather conditions on Mars to its planned manned exploration. It is thought that due to apparent low atmospheric surface pressure and insignificant water pressure vapor most weather problems familiar to the earth excepting those related to surface winds would be eliminated.

B. B.

A66-30356 #**THE POSSIBILITIES OF LIFE ON MARS.**

Frank B. Salisbury (Colorado State University, Fort Collins, Colo.).

IN: VIRGINIA POLYTECHNIC INSTITUTE, CONFERENCE ON THE EXPLORATION OF MARS AND VENUS, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA., AUGUST 23-27, 1965, PROCEEDINGS.

Conference supported by the National Aeronautics and Space Administration, and the U.S. Air Force Cambridge Research Laboratories.

Blacksburg, Va., Virginia Polytechnic Institute, 1965, p. VI-1 to VI-16. 17 refs.

Theoretical study of the possibilities of life on Mars. The possible existence of primitive plants, thriving advanced plants, and even of intelligent life on that planet are speculated upon. It is concluded that cases can be made for the existence of life and perhaps even of an advanced technology on Mars or - alternatively - for a lifeless moonlike Mars.

B. B.

A66-30713 #**MODELS FOR THE ATMOSPHERE OF MARS BASED ON THE MARINER 4 OCCULTATION EXPERIMENT.**

Gunnar Fjeldbo, Wencke C. Fjeldbo, and Von R. Eshleman (Stanford University, Center for Radar Astronomy, Stanford, Calif.).

Journal of Geophysical Research, vol. 71; May 1, 1966, p. 2307-2316. 20 refs.

Grants No. NGR-05-020-065; No. NSG-377.

Several possible atmospheric models are investigated based on data from the radio occultation experiment, and one is shown to be more likely than the others. Profiles in height of the constituent number densities, electron number density, temperature, pressure, and mass density are derived. The analysis indicates that Mars has a tenuous carbon dioxide lower atmosphere with a temperature of only about 180°K near the surface, and an atomic oxygen upper atmosphere with a temperature of only about 80°K. Frozen carbon dioxide particles may be an almost permanent feature of the atmosphere at intermediate altitudes. The main daytime ionospheric layer has its peak density at 120 km, and is most likely a Bradbury (F₂) layer with the principal ion (O⁺) being lost through O⁺ + CO₂ → O₂⁺ + CO. The atmospheric mass density decreases nearly ten orders of magnitude from the surface to the base of the exosphere at 140 km, thus remaining several orders of magnitude below the density of the earth's atmosphere at corresponding altitudes despite the lower gravity.

(Author)

A66-30889

A66-30889 #

PLANETARY ATMOSPHERIC DETERMINATION UTILIZING A SEMIPASSIVE PROBE.

Frank S. Holman and Haim Kennet (Boeing Co., Aero-Space Div., Seattle, Wash.).
(AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, UNMANNED SPACECRAFT MEETING, LOS ANGELES, CALIF., MARCH 1-4, 1965. AIAA Publication CP-12, p. 236-245.)
Journal of Spacecraft and Rockets, vol. 3, May 1966, p. 651-658.
9 refs.

A66-30925 #

THERMAL CONVECTION IN THE MARTIAN ATMOSPHERE.

F. M. Neubauer (Chicago, University, Dept. of Geophysical Sciences, Chicago, Ill.).
Journal of Geophysical Research, vol. 71, May 15, 1966, p. 2419-2426. 11 refs.

Formation of dust clouds observed in the Martian atmosphere can be explained by the action of dust devils larger than 100 meters in diameter. The condition for the onset of thermal convection is the existence of an unstable temperature profile. The daily variation of the atmospheric temperature profile shows that the Martian atmosphere is more favorable for the initiation of dust devils than the earth's atmosphere. The calculations indicate that dust devils on Mars produce wind velocities only slightly lower than those on earth.
(Author)

A66-31310 #

THE COMMISSION ON PLANETARY SURFACES - THE PLANET JUPITER IN 1963 [COMMISSION DES SURFACES PLANETAIRES - LA PLANETE JUPITER EN 1963].

M. Marin and M. Walbaum.
L'Astronomie, vol. 80, Apr. 1966, p. 151-156. In French.

Study of the surface of Jupiter, using results obtained by 29 observers in various parts of the world, but mainly in France. The observations made it possible to follow the slow evolution of atmospheric phenomena, which are described. Some comments are made on the characteristics of the Red Spot. Position measurements of details were made, and their periods of rotation were calculated.
F.R.L.

A66-32517 #

THE 10-MICRON LIMB DARKENING OF VENUS.

J. A. Westphal (California Institute of Technology, Div. of Geological Sciences, Pasadena, Calif.).
Journal of Geophysical Research, vol. 71, June 1, 1966, p. 2693-2696.
Grant No. NSG-56-60.

Observations of the 8- to 14- μ flux from diametric scans of Venus with the 200-in. Hale telescope operated in the east-arm Cassegrainian mode. The reduced data indicate an unexpected brightening near the Cytherean limb. The data show a more complicated atmospheric structure than that postulated by published models. Horizontal inhomogeneity of the emission complicates the interpretation.
W.M.R.

A66-33009

A RAPIDLY MOVING SPOT ON JUPITER'S NORTH TEMPERATE BELT.

Elmer J. Reese and Bradford A. Smith (New Mexico State University, Observatory, University Park, N. Mex.).
Icarus, vol. 5, May 1966, p. 248-257. 6 refs.
Grant No. NSG-142-61.

A very rapid drift in the longitude of a small dark spot on the south edge of Jupiter's North Temperate Belt (NTBs) has been determined from measurements of 51 photographic plates taken in blue and ultraviolet light at the New Mexico State University Observatory between July 7, 1964, and Apr. 1, 1965. During this interval of 268 days the NTBs spot made seven complete circuits of the planet relative to System II, i.e., the system which normally

applies to atmospheric currents in the planet's temperate latitudes. The mean daily drift of the spot was $-9^{\circ}.4056$ relative to System II, and $-10^{\circ}.7756$ relative to System I. This corresponds to a mean rotation period of $9^{\text{h}}49^{\text{m}}18^{\text{s}}.5$. A more detailed study of its motion disclosed a nearly sinusoidal displacement with respect to its mean position. A period of 300 days and an amplitude of 4° in longitude would best describe this oscillatory motion. The center of the spot remained stationary near zenographic latitude $+24^{\circ}$, within the probable error of the measures. This solitary spot apparently represents the fifth observed outbreak of activity in the well-known but rarely observed North Temperate Current "C," a current which has produced the shortest rotation periods ever recorded on Jupiter. There is evidence that the outbreak of rapidly rotating spots in this latitude may be periodic, as the spots tend to appear at 12-yr intervals when the North Temperate Belt lies nearest to the planet's equator. An outstanding characteristic of the most recent NTBs spot was its almost complete invisibility to the visual observer, and that it could be photographically recorded only on plates taken in blue and ultraviolet light.
(Author)

A66-33013

AN EXPERIMENTAL STUDY OF "TAYLOR COLUMNS."

R. Hide (Massachusetts Institute of Technology, Cambridge, Mass.) and A. Ibbetson (Woods Hole Oceanographic Institution, Woods Hole, Mass.).

Icarus, vol. 5, May 1966, p. 279-290. 17 refs.

Research supported by the Royal Society of London and the Department of Scientific and Industrial Research; Contract No. AF 61(052)-216; NSF Grant No. G-22390; Contract No. Nonr-2196(00).

Description of a theoretical and experimental investigation of Taylor columns as being likely to bear on processes occurring in Jupiter's atmosphere. Simple theoretical arguments suggest that for Taylor columns to arise in a homogeneous, inviscid, incompressible fluid that rotates uniformly about the z axis of coordinates of a Cartesian system, the ratio of the linear dimension in the z direction of the topographical feature to that of the fluid container must exceed a Rossby number based on the relative hydrodynamical flow velocity, on the linear dimensions in the x and y directions of the topographical feature, and on the basic rotation rate of the system, multiplied by a number of order unity. Systematic experiments were carried out on Taylor columns produced by moving solid objects through a liquid in a rotating cylindrical tank. They show that the theoretical criterion is probably correct and indicate how it is affected by viscosity.
M.M.

A66-34149

DIFUSE REFLECTION BY AN INHOMOGENEOUS PLANETARY ATMOSPHERE.

Joseph W. Chamberlain and Michael B. McElroy (Kitt Peak National Observatory, Tucson, Ariz.).
Astrophysical Journal, vol. 144, June 1966, p. 1148-1158. 8 refs.

An approximate solution is developed for the diffuse reflection by an inhomogeneous atmosphere - specifically one in which the albedo for single scattering, $\bar{\omega}$, decreases exponentially with optical depth τ . The approach consists of finding a homogeneous atmosphere ($\bar{\omega} = \text{constant}$) that closely mimics the intensities reflected by the inhomogeneous one. The solution for the diffusely reflected radiation is conveniently expressed in terms of an effective Chandrasekhar H function (which is strictly defined only for a homogeneous atmosphere). This H function (which depends on $\bar{\omega}$) thus specifies an effective mean albedo, $\bar{\omega}_e$, for the entire atmosphere. Then the optical depth where the local albedo is $\bar{\omega}_e$ defines, for purposes of this paper, an effective depth of absorption, τ_e . When $\bar{\omega}(\tau) \approx 1$ near the top of the atmosphere, which would be the case for weak absorption lines formed in a scattering atmosphere, we find $\tau_e \approx 1/2[3(1 - \bar{\omega}_e)]^{1/2}$. This expression differs by a factor of 1/2 from a similar one relating the mean depth of absorption, $\langle \tau \rangle$ (defined in an earlier paper as the centroid of the sink function), to the albedo $\bar{\omega}$ of a homogeneous atmosphere. The physical distinction between these two concepts (mean depth and effective depth) is discussed, as is the problem of defining a suitable mean depth of line formation in an inhomogeneous atmosphere. Numerical results from the simple approximation given here compare favorably, for a wide variety of cases, with the essentially exact results obtained from a computer

program developed by Bellman et al. In the appendices a number of integrals involving H functions are evaluated and Bellman's derivation of the basic integral equation for the inhomogeneous atmosphere is given with the more familiar notation and other conventions of Chandrasekhar. (Author)

A66-34712

ION-SPECTROMETER FOR THE TERRESTRIAL MESOSPHERE AND THE ATMOSPHERE OF MARS.

H. Dolezalek and A. L. Oster (Avco Corp., Space Systems Div., Wilmington, Mass.).

Zeitschrift für Geophysik, vol. 32, no. 3, 1966, p. 163-172. 17 refs. Contract No. DA-19-020-AMC-0058(X).

Description of the modifications in the design of a Gerdien-type chamber required for measurements of the mobility spectrum in the layers of the terrestrial upper atmosphere and in planetary atmospheres. Concentric rings are placed at both ends to compensate the inner and outer edge effects; ions can only enter through a concentric slit and during certain time intervals. Both electrodes of the chamber are subdivided so as to allow a sinusoidal driving voltage to be applied, with its amplitude increasing along the axis of the chamber. Ion numbers can be electrometrically measured for any selected mobility range. The instrument was tested in the laboratory, simulating the conditions of the lower ionosphere.

D. P. F.

A66-34896

THE MARINER IV MISSION TO MARS.

Carl Sagan (Harvard University, Harvard College Observatory; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).

Astronomical Society of the Pacific, Leaflet, July 1966, 8 p.

Analysis and interpretation of the data obtained by Mariner 4 on the planet Mars. The significance of the lack of an appreciable magnetic field for this planet is discussed; it suggests that no migration of iron from the mantle toward the core occurred. It is shown that the highly diminished differentiation on Mars as compared with earth would lead to correspondingly low levels of outgassing. The analysis of the results of the radio occultation experiment to determine the temperature at the base of the Martian atmosphere is described - a temperature of about 100°K is indicated, with a surface pressure in the range from 6 to 10 mb. An analysis of the photographs indicates that there has been crater erosion. Thus the past presence of water on Mars is highly probable.

D. P. F.

A66-35799

THE PLANET VENUS.

R. Jastrow (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies; Columbia University, New York, N. Y.) and S. I. Rasool (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies; New York University, New York, N. Y.). *Science Journal*, vol. 2, July 1966, p. 58-62.

Comparison of the atmospheres of Venus and the earth. The high surface temperature of Venus is attributed to the exceedingly thick and opaque atmosphere of this planet. It is shown that as a result of its high CO₂ content, the Venusian atmosphere absorbs about 99% of the reradiated planetary heat in comparison with 90% absorbed by the earth's atmosphere. An attempt is made to describe the surface of Venus. It is suggested that the reason for the marked divergence in the atmospheric characteristics of the two planets may lie in the answer to the question of whether or not Venus still retains its original atmosphere.

A. B. K.

A66-36605

EVAPORATIVE AND HYDRODYNAMICAL ATMOSPHERIC MODELS. J. Lemaire (Liège, Université, Institut d'Astrophysique, Liège, Belgium).

Annales d'Astrophysique, vol. 29, May-June 1966, p. 197-203. 15 refs.

Comparisons between (1) Chamberlain's evaporative model and his "solar breeze" model and (2) Öpik and Singer's evaporative

model and Parker's "solar wind" model ($\alpha = 3/2$) shows that, in both cases, the asymptotic behavior at great radial distances ($r \rightarrow \infty$) of the density (ρ), mean velocity (\bar{v}), and nonradial pressure components ($\mathcal{P}_{\theta\theta}$ or $\mathcal{P}_{\phi\phi}$) are the same for the evaporative and hydrodynamical models. In both evaporative models the radial component (\mathcal{P}_{rr}) of the pressure tensor is greater than the other ($\mathcal{P}_{\theta\theta}$ or $\mathcal{P}_{\phi\phi}$). This anisotropy grows with increasing radial distances. Therefore, the assumed isotropic pressure of the ordinary hydrodynamical models is probably too low. (Author)

A66-37016

THE NATURE OF THE CLOUD LAYER ON VENUS FROM MICRO-WAVE OBSERVATIONS.

A. E. Basharinov and B. G. Kutuza (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR).

(Astronomicheskii Zhurnal), vol. 43, Jan.-Feb. 1966, p. 149-153.

Soviet Astronomy, vol. 10, July-Aug. 1966, p. 117-120. 11 refs.

Translation.

A66-37017

SPECTROPHOTOMETRY OF THE METHANE ABSORPTION BANDS AT 0.7-1.0 μ ON THE DISK OF JUPITER.

V. G. Teifel' (Akademiia Nauk Kazakhskoi SSR, Astrofizicheskii Institut, Alma-Ata, Kazakh SSR).

(Astronomicheskii Zhurnal), vol. 43, Jan.-Feb. 1966, p. 154-156.

Soviet Astronomy, vol. 10, July-Aug. 1966, p. 121-123. Translation.

A66-37035

SPECTRA OF JUPITER AND SATURN IN THE REGION 1 TO 2.5 μ [SPEKTRY IUPITERA I SATURNA V OBLASTI 1 - 2.5 μ].

V. I. Moroz (Gosudarstvennyi Astronomicheskii Institut, Moscow, USSR).

Astronomicheskii Zhurnal, vol. 43, May-June 1966, p. 579-592.

41 refs. In Russian.

Results of a study at 1 to 2.5 μ of the spectra of Jupiter, Saturn, and the rings of Saturn, with resolutions of $\lambda/\Delta\lambda \approx 500, 150$, and 20, respectively. An "ordinary" reflection model is applied assuming that the cloud layer boundary is optically equivalent to a solid surface. The estimated CH₄ content over Jupiter's cloud layer is less than 150 m-atm. A possible substantial contribution of the H₂O band to the absorption at 2 μ is indicated and the planet's total atmospheric pressure is estimated at 2 atm. It is believed most likely that CH₄ ice particles form the cloud layer of Saturn and that H₂O ice particles form the rings.

V. Z.

A66-38022

MARTIAN ATMOSPHERE AND CRUST.

S. Miyamoto (Kyoto University, Institute of Astrophysics, Kwasan Observatory, Kyoto, Japan).

Icarus, vol. 5, July 1966, p. 360-374. 30 refs.

Analysis of the atmosphere and crust of the planet Mars. A tentative picture of the circulation pattern in the planet's northern hemisphere is proposed, based on cloud data. Mariner-4 photographs are used to analyze the crust of Mars, including the so-called "canals."

R. A. F.

A66-38024

TRANSMISSION OF THE ATMOSPHERE OF MARS IN THE REGION OF 2 μ .

L. D. Gray (California, University, Dept. of Engineering, Los Angeles, Calif.).

Icarus, vol. 5, July 1966, p. 390-398. 27 refs.

NASA-sponsored research.

The random Elsasser band model is used to compute the transmission of the atmospheres of earth and Mars for the 2- μ bands of carbon dioxide. This band model is shown to give good agreement with measurements of spectral transmission for homogeneous

A66-39455

paths of CO_2 and also for nonhomogeneous paths through the earth's atmosphere when the Curtis-Godson approximation is used. The $2\text{-}\mu$ bands of CO_2 are strong in the atmosphere of both earth and Mars and, at a given temperature, their absorption is a function only of the product mp . Comparison of calculated values for transmission of sunlight through both atmospheres indicates that $mp_{\text{J}} = 500 \pm 100 \text{ mr-atm-mb}$ where m is the amount of CO_2 in one air mass and p_{J} is the "effective" surface pressure. For $m_{\text{J}} = 60$ to 85 mr-atm , the above value of mp_{J} leads to $p_{\text{J}} = 7.1 \pm 2.2 \text{ mb}$ for the surface pressure of the Martian atmosphere. (Author)

A66-39455

TRANSIENT TEMPERATURE RESPONSE OF A POROUS MATRIX ENTERING A PLANETARY ATMOSPHERE.

Latif M. Jiji (New York City University, Dept. of Mechanical Engineering, New York, N.Y.).

Applied Scientific Research, vol. 15, no. 4-5, 1965, p. 322-330. 5 refs.

Analysis of the transient temperature behavior of a transpiration-cooled porous matrix entering a planetary atmosphere with constant velocity and negative entry angle. The analysis is based on one-dimensional heat conduction in a porous plate subjected to a time-dependent heat flux at one side and cooled internally by mass injection from a constant temperature reservoir at the opposite side. An exact closed-form solution is obtained, and temperature charts are given for a wide range of Fourier number and coolant flow parameters. (Author)

A66-39487

HYDROGEN MOLECULES IN ASTRONOMY.

G. B. Field, W. B. Somerville, and K. Dressler (Princeton University, New Observatory, Princeton, N.J.).

IN: ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS. VOLUME 4.

Edited by Leo Goldberg.

Palo Alto, Annual Reviews, Inc., 1966, p. 207-244. 155 refs.

Grant No. NSG-414.

Discussion of the astronomical implications of hydrogen. The structure of the hydrogen molecule and of molecular ions and polyatomic systems are discussed. Such aspects of hydrogen molecules in astrophysics as planetary and stellar atmospheres and interstellar space are considered, and the 14 discrete vibrational levels associated with the electronic ground state of hydrogen are investigated. B.B.

A66-39558

THE ABUNDANCE AND TEMPERATURE OF CO_2 IN THE MARTIAN ATMOSPHERE.

Michael J. S. Belton and Donald M. Hunten (Kitt Peak National Observatory, Tucson, Ariz.).

Astrophysical Journal, vol. 145, Aug. 1966, p. 454-467. 27 refs.

Spectrophotometric observations of the R-branch of the weak $\nu_1 + 2\nu_2 + 3\nu_3$ band of CO_2 at 1.05μ in the spectrum of Mars yield an atmospheric abundance of $68 \pm 26 \text{ m-atm (STP)}$. Taken together with the results of Gray's analysis of the strong bands of CO_2 at 2μ , this abundance indicates a surface pressure in the range of $5\text{-}13 \text{ mb}$. Individual lines in the R-branch have been resolved up to $J = 28$, and their intensity distribution indicates a rotational temperature of 194°K . The head region alone yields a somewhat higher temperature of 210°K . The observations were also analyzed with the help of a polytropic model atmosphere. The most satisfactory fit to the data was found for a maximum air temperature at the surface of 270°K and a lapse rate of 5°K km^{-1} . The paper is concluded with a brief discussion of the compatibility of the present observations with others that are available. (Author)

A66-40424

THE ATMOSPHERE OF MERCURY.

S. I. Rasool (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York University, Dept. of Meteorology and Oceanography, New York, N.Y.), S. H. Gross (Cutler-Hammer, Inc., Airborne Instruments Laboratory Div., Melville, N.Y.), and W. E. McGovern (New York University, Dept. of Meteorology and Oceanography, New York, N.Y.).

Space Science Reviews, vol. 5, Aug. 1966, p. 565-584. 43 refs. Grant No. NSG-499.

Review of information available on the temperature, composition, and surface pressure of Mercury's atmosphere and discussion of the implications of a nonsynchronous rotation of the planet on the atmosphere. Several models are constructed for the atmosphere which are consistent with the observations in an attempt to determine whether they are stable against depletion of the atmosphere by gravitational escape. The results are discussed from the standpoint of the origin of the atmosphere. M.M.

A66-40469

GREEN-HOUSE EFFECT IN THE ATMOSPHERE OF VENUS

[O TEPLICHNOM EFFEKTE V ATMOSFERE VENERY]. G. M. Strelkov.

Kosmicheskie Issledovaniia, vol. 4, July-Aug. 1966, p. 581-591. 24 refs. In Russian.

Analysis of the radiant-energy transfer below the cloud cover in the Venus atmosphere, on the assumptions that the atmosphere is in a state of local thermodynamic equilibrium, the energy transfer occurs only by absorption and reradiation, and that IR radiation is fully absorbed by the cloud cover. Two cases are considered: (1) the atmospheric absorption coefficient is independent of frequency ("gray" atmosphere), and (2) this coefficient at wavelengths between 8 and 12 mm is less appreciable than the absorption coefficient in the infrared. In both cases it is found that the presence of a cloud cover can not alone produce a green-house effect and that the latter must be caused by an atmosphere containing components capable of IR absorption. On the assumption that carbon dioxide in the two cases constitutes 5 and 15% of the total atmospheric mass of Venus respectively, estimates are obtained of the water vapor content which, together with the CO_2 content, will provide the required nontransparency in the $8\text{-to-}12\text{-mm}$ range. V.P.

A66-40478

MARTIAN WAVE OF DARKENING - A FROST PHENOMENON?

Joseph Otterman and Finn E. Bronner (General Electric Co., Missile and Space Div., King of Prussia, Pa.).

Science, vol. 153, July 1, 1966, p. 56-60. 25 refs.

Review of a new hypothesis which attributes the Martian "wave of darkening" to soil frost phenomena. It is thought that diurnal freezing and thawing of the ground, which uses moisture transported by the atmosphere from the melting polar cap, can produce various minute, frost-heaved, soil surface features which result in a complex, porous surface structure that causes optical darkening. The hypothesis is examined in terms of known properties of the Martian atmosphere and surface and of the availability of water. B.B.

A66-40486

MARS - NEW ABSORPTION BANDS IN THE SPECTRUM.

Janine Connes, Pierre Connes (Centre National de la Recherche Scientifique, Service d'Aéronomie, Observatoire de Meudon, Meudon, Seine-et-Oise, France), and Lewis D. Kaplan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

Science, vol. 153, Aug. 12, 1966, p. 739, 740.

Note on the finding of new absorption bands in the near-IR spectrum of Mars by Fourier spectroscopy. They are tentatively identified in part as due to reduced gases in the Martian atmosphere. The Mars spectra were obtained mainly to measure absorption by lines in the $1.6\text{-}\mu$ CO_2 bands to make it possible to estimate the surface pressure more precisely. B.B.

A66-41063 #**STABILITY ANALYSIS OF SATURN'S RINGS WITH DIFFERENTIAL ROTATION.**

Shin Yabushita (Yale University, Astronomy Dept., Yale Observatory, New Haven, Conn.).

Royal Astronomical Society, Monthly Notices, vol. 133, no. 3, 1966, p. 247-263. 10 refs.

USAF-supported research.

A method is presented for calculating the potential due to an arbitrary thin gravitating ring by making use of cylindrical functions. The equilibrium configuration of the ring is defined in such a way that centrifugal force exactly balances the self-gravitation of the ring plus the gravitation due to the (spherical) planet. By taking into account the differential rotation obtained in this manner mathematical analysis of the stability of motion about the equilibrium configuration is carried out by making use of the equations of hydrodynamics. Frequencies of the free oscillations are shown to be given as eigenvalues of a certain infinite matrix, and the eigenvalue problem is then solved numerically. The upper limit to the mass of a ring which is stable against axisymmetric perturbations is given for several model rings. If the density distribution of the ring is taken as a linear combination of the zero-order Bessel functions of the first and second kind such that the density vanishes at the inner ($r = a$) and outer ($r = b$) boundaries, the limiting mass

A66-41181**DIRECT PHOTOGRAPHIC EVIDENCE OF A RETROGRADE ROTATION OF VENUS IN FOUR DAYS [MISE EN EVIDENCE DIRECTE, PAR LA PHOTOGRAPHIE, D'UNE ROTATION RETROGRADE DE VENUS EN 4 JOURS].**

Charles Boyer and Pierre Guérin (Centre National de la Recherche Scientifique, Institut d'Astrophysique, Paris; Toulouse, Université, Observatoire du Pic du Midi, Bagnères de Bigorre, Hautes-Pyrénées, France).

Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques, vol. 263, no. 3, July 18, 1966, p. 253-255. In French.

Results of a study of continuous series of high resolution photographs of Venus, obtained for the first time from the same station (the Pic-du-Midi Observatory) several hours running. A retrograde rotation of the whole of the cloud formations of the planet was observed with an angular velocity corresponding to one complete rotation in about four days. This period is noted to be physically incompatible with the period of 240 days obtained by radar.

M. F.

A66-41679**ON THE CIRCULATION OF THE ATMOSPHERES OF JUPITER AND SATURN.**

R. Hide (Massachusetts Institute of Technology, Dept. of Geology and Geophysics, and Dept. of Physics, Cambridge, Mass.).

Planetary and Space Science, vol. 14, Aug. 1966, p. 669-675. 24 refs.

NSF Grant No. G-22390.

Discussion of the planetary-scale atmospheric circulations of Jupiter and Saturn in terms of basic fluid dynamics. Owing to the great size of these planets, effects of rotation are even more pronounced than in the case of the earth. There is evidence that in the case of Jupiter hydromagnetic effects may have to be taken into account. There is direct spectroscopic evidence for the existence of methane and ammonia in the atmospheres of Jupiter and Saturn. The presumption that the main constituents of these atmospheres are hydrogen and helium is based on the low mean densities of the two planets, and, in the case of Jupiter, on a measurement of the light variation of a star during an occultation, leading to an estimate of the mean molecular weight of the material above the cloud level.

M. F.

A66-41779**ATMOSPHERE OF MARS - MARINER IV MODELS COMPARED.**

Gunnar Fjeldbo, Wencke C. Fjeldbo, and Von R. Eshleman (Stanford University, Center for Radar Astronomy, Stanford, Calif.).

Science, vol. 153, Sept. 23, 1966, p. 1518-1523. 25 refs.

Grants No. NGR-05-020-065; No. NSG-377.

Discussion of three classes of models for the atmosphere of Mars which differ in identifying the main ionospheric layer measured by Mariner 4 as being analogous to a terrestrial F_2 , F_1 , or E layer. At an altitude of several hundred kilometers, the relative atmospheric mass densities for these models are approximately 10^2 , 10^3 , and 10^4 , respectively, and the temperatures are roughly 100, 200, and 400°K. Theory and observation are in best agreement for an F_2 model, for which photodissociation of CO_2 and diffusive separation result in an atomic-oxygen upper atmosphere, with O^+ being the principal ion in the isothermal topside of the ionosphere. However, an F_1 model, with molecular ions in a mixed and warmer upper atmosphere, might result if photodissociation and diffusive separation are markedly less than would be expected from analogy with the earth's upper atmosphere.

M. M.

A66-41816**RESOLUTION OF A CO_2 "HOT BAND" IN THE VENUS SPECTRUM.**

Hyron Spinrad (California, University, Berkeley Astronomical Dept., Berkeley, Calif.).

Astrophysical Journal, vol. 145, Sept. 1966, p. 943-945.

Study of very weak absorption lines observed on spectrograms of Venus in the region $\lambda\lambda$ 8736-8768. These faint lines are mainly the rotational fine structure of the excited vibrational transition of CO_2 designated 010-015 (ν_2 to $5\nu_3 + \nu_2$). The weak "hot-band" lines are best visible near λ 8760; the strongest lines in the P-branch Charles H. McLellan and E. Brian Pritchard (NASA, Langley Research Center, Aero-Physics Div., Mission Analysis Group, Hampton, Va.).

A66-42320 #**OSCILLATIONS OF PLANETARY ATMOSPHERES AS A FUNCTION OF THE ROTATIONAL SPEED OF THE PLANET.**

G. S. Golitsyn and L. A. Dikii (Akademiia Nauk SSSR, Institut Fiziki Atmosfery, Moscow, USSR).

(Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana, vol. 2, Mar. 1966, p. 225-235.)

Academy of Sciences, USSR, Izvestiya, Atmospheric and Oceanic Physics, vol. 2, Mar. 1966, p. 137-142. 13 refs. Translation.

[For abstract see issue 14, page 2381, Accession no. A66-27534]

A66-42667**HIGH RESOLUTION SPECTRA OF PLANETARY ATMOSPHERES.**

Hyron Spinrad (California, University, Berkeley, Calif.).

IN: UNMANNED EXPLORATION OF THE SOLAR SYSTEM; AMERICAN ASTRONAUTICAL SOCIETY, SYMPOSIUM ON UNMANNED EXPLORATION OF THE SOLAR SYSTEM, DENVER, COLO., FEBRUARY 8-10, 1965, PROCEEDINGS.

Edited by G. W. Morgenthaler and R. G. Morra.

Baltimore, American Astronautical Society; North Hollywood, Calif., Western Periodicals Co. (Advances in the Astronautical Sciences. Volume 19), 1965, p. 187-197.

Some results of recent spectroscopic observations of the physical characteristics of planetary atmospheres. The significance of CO_2 lines in the atmospheric spectra of Mercury, Mars, and Venus is discussed. The data obtained have contributed to the understanding of the composition, pressures, and temperatures of the atmospheres of some of the planets. The observational techniques used in the experiments and the understanding of the transfer of radiation in these atmospheres are believed to be still rather poor.

S. Z.

A66-42668**THE ATMOSPHERE OF VENUS.**

Patrick Thaddeus (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N.Y.).

IN: UNMANNED EXPLORATION OF THE SOLAR SYSTEM; AMERICAN ASTRONAUTICAL SOCIETY, SYMPOSIUM ON UNMANNED EXPLORATION OF THE SOLAR SYSTEM, DENVER, COLO., FEBRUARY 8-10, 1965, PROCEEDINGS.

Edited by G. W. Morgenthaler and R. G. Morra.

Baltimore, American Astronautical Society; North Hollywood, Calif., Western Periodicals Co. (Advances in the Astronautical Sciences. Volume 19), 1965, p. 201-212. 25 refs.

A66-42680

The observed decline in the microwave brightness temperature of Venus at frequencies above 30 Gc is most easily interpreted in terms of pressure-induced absorption in a CO₂-N₂ atmosphere. Calculations using recent estimates of the CO₂ abundance and laboratory measurements of induced absorption in model atmospheres indicate that the ground pressure on Venus may lie in the range of 100-200 atm. At such high pressures it is probable that the atmosphere will have the high opacity in the range from 1-20 μ required for the Greenhouse effect even if the CO₂ abundance is as low as 0.5%, and water vapor is absent. (Author)

A66-42680

USE OF ENTRY VEHICLE RESPONSES TO DEFINE THE PROPERTIES OF THE MARS ATMOSPHERE.

Alvin Seiff and David E. Reese, Jr. (NASA, Ames Research Center, Vehicle Environment Div., Moffett Field, Calif.).

IN: UNMANNED EXPLORATION OF THE SOLAR SYSTEM; AMERICAN ASTRONAUTICAL SOCIETY, SYMPOSIUM ON UNMANNED EXPLORATION OF THE SOLAR SYSTEM, DENVER, COLO., FEBRUARY 8-10, 1965, PROCEEDINGS.

Edited by G. W. Morgenthaler and R. G. Morra.

Baltimore, American Astronautical Society; North Hollywood, Calif., Western Periodicals Co. (Advances in the Astronautical Sciences. Volume 19), 1965, p. 419-445. 24 refs.

Development of the principles by which the atmospheric properties of an unknown planetary atmosphere can be deduced from responses of a probe vehicle entering the atmosphere. Experiments to determine atmospheric density and pressure as functions of altitude, and to detect and determine quantities of selected gases in the atmosphere are examined in detail. Accuracies and experiment problem areas are treated. Measurements of altitude profiles of atmospheric density, pressure, and temperature are discussed, and the detection of chemical species in the shock layer by spectrometry is studied. M. F.

A67-11424 #

SYSTEMS CONSIDERATIONS FOR A PLANETARY ENTRY PROBE.
P. A. Giragosian and M. S. Parker (Raytheon Co., Lexington, Mass.).

International Astronautical Federation, International Astronautical Congress, 17th, Madrid, Spain, Oct. 9-15, 1966, Paper. 8 p.

Design formulation of a small lightweight probe to define the atmospheric proportion of Mars from its dynamic response during entry. Studies of various blunt configurations indicate that a sphere is the optimum shape for such a probe. An efficient lightweight decelerator to damp the motions of the vehicle is used to maintain a zero angle of attitude. A radiometer to measure atmospheric constituents, four pressure transducers, a temperature sensor, and a data-handling and communications system for the proposed vehicle are described. The total weight of the proposed atmospheric probe is 25 lb. W. A. E.

A67-11432 * #

AEROTHERMOSTRUCTURAL DESIGN OF A FLIGHT CAPSULE SYSTEM ENTERING LOW DENSITY MARS ATMOSPHERE.

H. Hurwicz, O. L. Zappa, and R. M. Davis (Avco Corp., Space Systems Div., Lowell, Mass.).

International Astronautical Federation, International Astronautical Congress, 17th, Madrid, Spain, Oct. 9-15, 1966, Paper. 25 p. 14 refs.

Contract No. NAS 1-5224.

Discussion of the basic aerodynamic, thermodynamic, and structural design aspects of a flight capsule entering a low-density Mars atmosphere from orbit. The effect of change in the atmosphere is brought out by comparisons with a capsule designed for entry from an approach trajectory into a dense atmosphere. The results are tabulated. An aerodynamic retardation system for rare atmospheres is concluded to be feasible for a blunt cone entering from orbit. Aerodynamic load reduction permits significant (but not proportional) weight structural saving and/or use of conventional materials. M. M.

A67-11436 #

NON-EQUILIBRIUM PROPERTIES OF MARTIAN ENTRY FLOW FIELDS.

Stanley Byron and Richard M. Foster (Philco Corp., Aeronutronic Div., Newport Beach, Calif.).

International Astronautical Federation, International Astronautical Congress, 17th, Madrid, Spain, Oct. 9-15, 1966, Paper. 14 p. 24 refs.

Brief description of the present status of three phases of work for developing a satisfactory model of the nonequilibrium properties of high-temperature CO₂, N₂, and Ar mixtures. Specifically, the three phases are development of a satisfactory nonequilibrium chemical model, verification of the chemical model by comparing theoretical results with time-resolved radiation emission measurements behind normal shocks, and calculation of flight cases using the chemical model and a suitable flow-field analysis. The results obtained show that the chemical model satisfactorily reproduces previously published experimental measurements. In addition, flight calculations show that nonequilibrium and equilibrium radiative heating are comparable with stagnation-point convective heating. M. M.

A67-11695

THE COMPOSITION AND SURFACE PRESSURE OF THE MARTIAN ATMOSPHERE - RESULTS FROM THE 1965 OPPOSITION.

Tobias Owen (Illinois Institute of Technology, Research Institute, Astro Sciences Center, Chicago, Ill.; Arizona, University, Lunar and Planetary Observatory, Tucson, Ariz.).

1967

IAA ABSTRACTS

A67-11395 #

MANNED SATELLITE OBSERVATIONS AND PLANETARY RESEARCH.

D. Deirmendjian (RAND Corp., Santa Monica, Calif.).

International Astronautical Federation, International Astronautical Congress, 17th, Madrid, Spain, Oct. 9-15, 1966, Paper. 12 p. 9 refs.

Discussion of certain terrestrial observations from a manned geophysical satellite as training for research on other planets. The experience thus acquired is essential in solving some of the problems of the Venusian atmosphere by means of a properly designed fly-by mission. Observations of the natural optical phenomena produced by sunlight falling on the clouds in the atmosphere, especially glories, can provide much information concerning the atmosphere itself. We still lack basic reliable data concerning the constitution, state, and amount of the atmosphere, and a manned fly-by mission may be a great help in resolving these uncertainties. W. A. E.

Astrophysical Journal, vol. 146, Oct. 1966, p. 257-270. 36 refs.
Research supported by the Illinois Institute of Technology; Grant No. NRO-46-791.

Observations of the photographic spectrum of Mars obtained at the most recent opposition in March 1965 are presented and discussed. The absence of any trace of the NO_2 absorption at 4480 \AA confirms previous upper limits set on the abundance of this gas. Observations of the weak CO_2 bands at 8689 \AA and $10,488 \text{ \AA}$ lead to a derivation of $65 \pm 20 \text{ m-atm}$ for the abundance of CO_2 in the Martian atmosphere. This abundance is used with new observations of the strong CO_2 bands at 1.6μ made by Kuiper to derive a value for the surface pressure of 9 mb. The uncertainty in this determination ranges from 5 to 20 mb, the lower values being considered most probable. A discussion of these results in the context of the origin and development of the Martian atmosphere suggests that, with the exception of water vapor, the present atmospheric composition may be very similar to that of the primitive, outgassed terrestrial atmosphere. (Author)

A67-11769

WATER VAPOR IN THE ATMOSPHERE OF VENUS.

M. J. S. Belton and D. M. Hunten (Kitt Peak National Observatory, Tucson, Ariz.).

Astrophysical Journal, vol. 146, Oct. 1966, p. 307, 308. 6 refs.
Commentary on water-vapor lines detected in the spectrum of Venus. These lines were Doppler-shifted from the normal wavelengths of 8189.27 and 8193.00 \AA . The spectra were obtained by photoelectric scanning of the Venus spectrum formed by the 40-ft spectrograph of the McMath Solar Telescope. The technique used to disentangle the Venus lines from their strong telluric counterparts are described. W.A.E.

A67-11774

WATER VAPOR ON VENUS - A CONFIRMATION.

Hyron Spinrad and Stephen J. Shawl (California, University, Dept. of Astronomy, Berkeley, Calif.).

Astrophysical Journal, vol. 146, Oct. 1966, p. 328, 329. 7 refs.
Navy-supported research.

Discussion of several Doppler-displaced lines of water vapor originating in the atmosphere of Venus which were observed on three coude spectrograms. The Cytherean absorption lines were quite weak, and a dispersion of 1.9 \AA/mm was required to detect them. The study is considered to confirm the detection of water on Venus by balloon by Bottema et al. and recent ground-based photoelectric observations by Belton and Hunten. F.R.L.

A67-12406

PERTURBATION TO TEMPERATURE SOUNDINGS BY BOUNDARIES AND ATTENUATING MEDIA.

Ralph Zirkind (Brooklyn, Polytechnic Institute, Brooklyn, N.Y.).
International Astronautical Federation, International Astronautical Congress, 17th, Madrid, Spain, Oct. 9-15, 1966. 10 p. 5 refs.

The radiometric sounding of planetary atmospheres by remote sensing techniques to obtain temperature profile data may be affected by boundary conditions and attenuating media. An attempt is made to consider these influences as a function of wavelength. The results indicate that at the short infrared wavelengths, surface radiation plays a minor role whereas at the longer wavelengths it may be serious. The effect of clouds is important in the window regions of the spectrum where significant portions of the total radiation are emitted. There is proposed (1) a generalized scheme for analysis of planetary atmospheres and (2) an inversion process that would employ a fictitious absorption coefficient. (Author)

A67-12949 *

LABORATORY MEASUREMENT OF MICROWAVE ABSORPTION IN MODELS OF THE ATMOSPHERE OF VENUS.

W. Ho, I. A. Kaufman (Columbia University, Columbia Radiation Laboratory, New York, N.Y.), and P. Thaddeus (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N.Y.).

Journal of Geophysical Research, vol. 71, Nov. 1, 1966, p. 5091-5108. 62 refs.

Grant No. NSG-442; Contract No. DA-28-043-AMC-00099(E).

Measurement of coefficients of induced absorption in model atmospheres containing CO_2 , N_2 , A, and Ne, needed to calculate the properties of the lower atmosphere of Venus from the radio observations on the assumption that the atmosphere is dry and massive, in the temperature range 240 to 500°K to pressures as high as 130 atm . Since the microwave region lies on the low-frequency wing of both the translational and rotational spectrum, the microwave-induced absorption coefficient is proportional to the square of the frequency, and all measurements have been made at one frequency, 9260 Mc . Absorption due to small amounts of water vapor in N_2 has also been studied at 9260 Mc , over a comparable pressure range, and over the temperature interval 393 to 473°K . The absorption coefficient in this case is found to be approximately twice that calculated on the basis of the Van Vleck-Weisskopf theory from all of the significant microwave and IR transitions of the water molecule. An expression for the absorption coefficient for all the atmospheres studied is given. M.F.

A67-13215 *

ACOUSTIC EXPERIMENT TO DETERMINE THE COMPOSITION OF AN UNKNOWN PLANETARY ATMOSPHERE.

R. A. Hanel and M. G. Strange (NASA, Goddard Space Flight Center, Greenbelt, Md.).

Acoustical Society of America, Journal, vol. 40, Oct. 1966, p. 896-905. 15 refs.

Measurement of the speed of sound and the acoustic impedance, combined with a knowledge of ambient pressure and temperature, provide sufficient data for determining the relative abundance of constituents in a mixture of nitrogen, argon, and carbon dioxide. Sound absorption and dispersion yield additional information for checking the consistency of the results. An instrument has been developed to measure the acoustic properties of an unknown gas mixture. Laboratory results demonstrate the feasibility of determining the gas composition within a few percent. The technique of velocity measurement by use of phase comparison over several wavelengths is quite sensitive and may be useful in other applications. (Author)

A67-14088 *

RADIATION EQUILIBRIA PERTINENT TO PLANETARY ATMOSPHERES.

P. Harteck, R. R. Reeves, Jr., B. A. Thompson, and R. W. Waldron (Rensselaer Polytechnic Institute, Dept. of Chemistry, Troy, N.Y.).

(International Symposium on Atmospheric Chemistry, Circulation and Aerosols, Visby, Sweden, Aug. 18-25, 1965, Paper.)
Tellus, vol. 18, no. 2-3, 1966, p. 192-197. 18 refs.

NASA-supported research.

Investigation of radiation equilibria in the UV by means of a bromine lamp which gives 10^{17} quanta/sec at 1582 and 1633 \AA where the latter is the most intense Br line. Since the absorption coefficients of O_2 , CO_2 , and O_3 and other gases are substantial at these wavelengths, radiation equilibria can be obtained in times between 1 hr and a few days, depending on conditions, in a 500-ml sample volume. Since the temperature can also be varied, the conditions prevailing in any region of an atmosphere can be simulated. The irradiation of O_2 , CO , CO_2 , N_2 , and mixtures of these gases is discussed, together with the effects of trace amounts of water vapor on the equilibria. M.M.

A67-14309 *

HIGH-DISPERSION SPECTROSCOPIC OBSERVATIONS OF MARS. I. Hyron Spinrad, L. P. Giver (California, University, Astronomical Dept., Berkeley, Calif.), Ronald A. Schorn (California Institute of Technology, Jet Propulsion Laboratory, Space Science Div., Pasadena, Calif.), Roger Moore (RAND Corp., Santa Monica, Calif.), and Harlan J. Smith (Texas, University, McDonald Observatory, Fort Davis, Tex.).

Astrophysical Journal, vol. 146, Nov. 1966, p. 331-338. 15 refs. NASA-supported research; Grant No. Nonr(G)-00006-66.

From high-dispersion infrared McDonald and Lick Observatories' spectrograms of Mars we have determined a CO₂ abundance of 90 ± 27 (estimated error) m-atm (STP) at 200°K, chosen as a representative lower-atmosphere temperature. We used the weak 5 ν_3 CO₂ lines near λ 8700 Å. An abundance of 90 m-atm of CO₂ gives a surface partial pressure of 6.6 mb. The observation and reductions are discussed. The result is compared to the Mariner 4 occultation data which yield $P_s = 5$ or 6 mb if the temperature of the lower Martian atmosphere is 180°K. The difference in surface pressure is not substantial; the occultation results coupled with our CO₂ abundance suggest an almost pure CO₂ atmosphere for Mars.

(Author)

A67-14310

A DISCUSSION OF THE DEEP CIRCULATION OF THE ATMOSPHERE OF VENUS.

Richard M. Goody (Kitt Peak National Observatory, Tucson, Ariz.) and Allan R. Robinson (Harvard University, Cambridge, Mass.). *Astrophysical Journal*, vol. 146, Nov. 1966, p. 339-355. 19 refs. NSF Grant No. G-24903.

Examination of a model of the Venusian atmosphere which is completely opaque to both solar and planetary radiation, but which is in motion because of presumed differential heating between subsolar and antisolar points, to determine whether deep penetration of solar radiation is the only possible mechanism for maintenance of temperatures of ~600°K at the base of the Venus cloud layer. It is argued that the geometry of the system favors moderate vertical mixing coefficients (~10⁴ cm²/sec) and that the inflow of solar energy is large enough to maintain an essentially nonlinear boundary layer near the cloud tops. The less probable case of very large turbulent coefficients is also considered, and it is shown that the interior will remain adiabatic, although the nature of the flow will differ.

B. B.

A67-14327

AN IDENTIFICATION OF THE 6800-Å METHANE BAND IN THE SPECTRUM OF URANUS AND A DETERMINATION OF ATMOSPHERIC TEMPERATURE.

Tobias Owen (Illinois Institute of Technology, Research Institute, Chicago, Ill.; Kitt Peak National Observatory, Tucson, Ariz.). *Astrophysical Journal*, vol. 146, Nov. 1966, p. 611-613. 7 refs.

Description of the results of the identification of the 6800-Å methane band in the spectrum of Uranus for the determination of this planet's atmospheric temperature. The mean values of the wavelengths of the methane lines measured are tabulated. The relative intensities of the R-branch lines were examined as a clue to the mean temperature of the visible atmosphere of Uranus. The best estimate obtained on the available material was $60 \pm 15^\circ\text{K}$. This temperature is very close to the maximum subsolar temperature to be expected if the planet is in simple equilibrium with the incoming solar radiation (67°K), a very different situation from that of Jupiter.

M. M.

A67-14699

THE ULTRAVIOLET SPECTROSCOPY OF PLANETS.

C. A. Barth (Colorado, University, Dept. of Astro-Geophysics, and Physics and Astrophysics Dept., Laboratory for Atmospheric and Space Physics, Boulder, Colo.).

IN: THE MIDDLE ULTRAVIOLET: ITS SCIENCE AND TECHNOLOGY.

Edited by A. E. S. Green.

New York, John Wiley and Sons, Inc., 1966, p. 177-218. 35 refs.

Consideration of the phenomena that occur when a planetary atmosphere is subjected to radiation from the sun. Such radiation directly or indirectly subjects the upper atmosphere to charged particle bombardment at large geomagnetic latitudes. The phenomena producing dayglow include resonance reradiation, fluorescence, photoelectron excitation, and chemical and ionic reactions. The spectral emissions of the aurora are produced by charged particle bombardment while the aurora itself is controlled in some way by the geomagnetic field. Atoms that may play a role in producing spectra in the upper atmospheres of Venus, the earth, and Mars are hydrogen, oxygen, nitrogen, argon, and carbon. Molecules that may be important in producing planetary emission spectra are nitrogen, oxygen, nitric oxide, carbon monoxide, the hydroxyl radical, the cyanogen radical, and the molecular ions of nitrogen, oxygen, nitric oxide, and carbon monoxide. Planetary molecular spectra are calculated, and UV spectra of the earth are considered.

F. R. L.

A67-14952 * #

SOME COMMENTS ON THE VENUS TEMPERATURE.

D. C. Applebaum, P. Harteck, R. R. Reeves, Jr., and B. A. Thompson (Rensselaer Polytechnic Institute, Dept. of Chemistry, Troy, N.Y.).

Journal of Geophysical Research, vol. 71, Dec. 1, 1966, p. 5541-5545. 29 refs.

NASA-supported research.

The observed microwave emission from Venus has been widely attributed to a high surface temperature for the planet. A lack of realistic models to account for such a high temperature has led to a search for alternative interpretations for the emission. The paper describes experiments in which anomalous signals have been observed in the X-band region from glow discharges through CO₂ and SO₂. Although this type of emission may not necessarily be the source of the microwave emission from Venus, the fact that it occurs points out the need for caution in basing conclusions about the surface temperature on microwave observations.

(Author)

A67-15557

THE SPECTRA OF JUPITER AND SATURN IN THE 1.0-2.5 μ REGION.

V. I. Moroz (Moskovskii Gosudarstvennyi Universitet, Astronomicheskii Institut, Moscow, USSR).

(*Astronomicheskii Zhurnal*, vol. 43, May-June 1966, p. 579-592.)

Soviet Astronomy, vol. 10, Nov.-Dec. 1966, p. 457-468. 41 refs. Translation.

[For abstract see issue 20, page 3647, Accession no. A66-37035]

A67-16029 #

VENUS - A HOT PLANET? [DIE VENUS - EIN HEISSER PLANET?]. Alexander Lebedinski (Akademii Nauk SSSR, Moscow, USSR) and Wsewolod Wachnin.

Weltraumfahrt Raketentechnik, vol. 17, 4th Quarter, 1966, p. 138, 139. In German.

Discussion of a hypothesis according to which "global breezes" in the Venus atmosphere - which are characterized by high velocities and low vorticity - create conditions in which glow discharges of low luminous intensity can develop. This being the case, the surface

temperature of Venus may be as little as 50 to 60°C, while the increase in the equivalent temperature of noise radiation, caused by the glow discharges, can amount to 200 to 250°C. V.P.

A67-16298

RADAR OBSERVATIONS OF VENUS AT 3.8-CM WAVELENGTH.
J. V. Evans, R. P. Ingalls, L. P. Rainville, and R. R. Silva
(Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Mass.).

Astronomical Journal, vol. 71, Nov. 1966, p. 902-915. 32 refs.

During the early part of 1966 the Haystack radar ($\lambda = 3.8$ cm) was employed to observe the planet Venus. The radar cross section observed at this wavelength was only about one-tenth as much as has been reported at wavelengths of 12 cm or longer. Our measurements support the low value for the cross section reported by Karp et al. (1964). The echo spectrum is found to be comparatively narrow, suggesting the solid surface as the reflecting agent. No echo power can be observed outside the frequency limits expected on the basis of the known rotation rate and the center Doppler shift measured using a separate $\lambda = 23$ cm radar. If any energy is reflected by the atmosphere it appears to be only a small portion of the total. Confirmation that the surface is the scattering agent has been provided by near simultaneous ranging experiments at two frequencies, which showed that the echo delay times agreed to 5 μ sec - i.e., well within the experimental accuracy. The depolarized component of the echoes was observed and found to be of the order of 14 db weaker than the expected component. An analysis of the scattering law for the planet has been made, and when compared with the law observed at longer wavelengths indicates that about 4-6 db two-way vertical absorption occurs in the atmosphere of Venus. Variations in the observed cross section with time (by as much as a factor of 2) support the view that atmospheric attenuation is responsible at least in part for the low cross section observed. A comparison of the positions of anomalously reflecting regions observed in these observations with the positions reported by Carpenter (1966) during the 1964 inferior conjunction permits the Venus rotation period to be established as 244 days plus or minus a few days. (Author)

A67-16407

THE PRESENCE OF ICE IN THE VENUS ATMOSPHERE AS INFERRED FROM A HALO EFFECT.
Brian T. O'Leary.

Astrophysical Journal, vol. 146, Dec. 1966, p. 754-766. 18 refs.

Discussion of photometry of the integrated light of Venus in blue, violet, and red between phase angles of 153 and 165° before and after the inferior conjunction of 1966. These results, combined with a study of the photometric, colorimetric, and polarimetric characteristics of Venus as it passes through these phase angles, suggest a halo effect of brightness dispersions of about 0.05 magnitude brighter than the background phase-curve at predicted halo maximum and about 0.04 magnitude fainter than the background phase-curve at predicted halo minimum. The findings tentatively indicate confirmation of H₂O in the Venusian atmosphere, and a temperature and pressure environment at the cloud tops conducive to the formation of ice. B.B.

A67-18052

A POSSIBLE FACTOR REGULATING THE AMOUNT OF THE ATMOSPHERE ON THE EARTH AND MARS.
Makoto Komabayasi (Nagoya University, Water Research Laboratory, Nagoya, Japan).

Meteorological Society of Japan, Journal, vol. 44, Oct. 1966, p. 297-300. 10 refs.

Examination of a possible mechanism which can regulate the total amount of a planetary atmosphere that is transparent for visible and IR radiation. It has been suspected that molecules of the atmospheric gas can escape from the top of the atmosphere (exosphere) into the planetary space by either thermal or nonthermal

evaporation if appropriate conditions are satisfied. The rates of escape as a function of the amount of a model atmosphere under conditions of the earth and of Mars are tabulated. It is noted that the equilibrium amounts of the earth and Mars are on the same order of magnitude as the amount of the actual atmospheres of these planets. M.F.

A67-18287 *#

DEFINITION OF SCIENCE SUBSYSTEMS FOR JUPITER FLYBY MISSIONS.

B. A. Sodek and J. C. Redmond (General Dynamics Corp., Applied Research Laboratory, Fort Worth, Tex.).

American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 5th, New York, N.Y., Jan. 23-26, 1967, Paper 67-120. 17 p. 29 refs.

Members, \$0.75; nonmembers, \$1.50.

Contract No. JPL-951285.

Summary of the present state of knowledge about Jupiter, followed by a description of those features to be studied in unmanned flyby missions. A general discussion of scientific experiments and instruments that can gather pertinent data, an evaluation of the relative priority of the information returned, and an indication of some special considerations in their application are presented. It is necessary to define realistic approximations of the science payloads at the present time, both for determining what information a Jupiter mission can provide and to examine the interface areas between the acquisition of scientific data and the other considerations involved in planning the mission. These considerations include such items as spacecraft trajectory and orientation, both in interplanetary space and at Jupiter; spacecraft design, including constraints on the vehicle configuration, weight and size; and data handling, including storage and transmission. (Author)

A67-18310 *#

A RADIO OCCULTATION EXPERIMENT TO PROBE THE ATMOSPHERE OF VENUS.

Arvydas Kliore, Dennis A. Tito, Dan L. Cain, and Gerald S. Levy (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 5th, New York, N.Y., Jan. 23-26, 1967, Paper 67-118. 13 p. 29 refs.

Members, \$0.75; nonmembers, \$1.50.

This paper describes an experiment planned for the encounter of the Mariner Venus 1967 space probe. Changes in the frequency, phase and power of the S-band radio signal introduced by its passage through the atmosphere of Venus, will be observed, and the analysis of these changes will lead to a profile of refractive index. These data, together with the results of other measurements, are expected to yield profiles of pressure and density in the lower atmosphere, and provide information on its composition. The philosophy underlying the design of the trajectory and high-gain antenna of the probe was based on the maximization of the information returned by this experiment under the adverse effects of defocusing attenuation and refractive bending expected in the dense atmosphere of Venus. Finally, the expected frequency, phase and signal strength effects computed for several models of the atmosphere of Venus are presented. (Author)

A67-18311 *#

A METHOD FOR STUDYING PLANETARY ATMOSPHERES EMPLOYING THE DUAL FLYBY MODE.

J. Michael Coogan (NASA, Office of Advanced Research and Technology, Mission Analysis Div., Moffett Field, Calif.).

American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 5th, New York, N.Y., Jan. 23-26, 1967, Paper 67-121. 11 p. 27 refs.

Members, \$0.75; nonmembers, \$1.50.

The major factors bearing on the theoretical and technological feasibilities of a split-trajectory dual planetary flyby mode and its application to absorption spectroscopy of a planetary atmosphere have been examined. In this mode, a piggyback capsule is launched

A67-18429

from a conventional planetary flyby vehicle with proper timing and thrust so that the capsule also flies by the planet, but on the opposite side. If one of the flyby platforms carries a suitable light source, in particular a solar mirror, and the other carries a compatible spectrophotometer, absorption-altitude profile measurements can be made at useful wavelengths as the line of sight between them sweeps through the planetary atmosphere. From these profiles the absolute density vs altitude of the absorbing constituents can be determined with certain qualifications. For a Mars-like 10 mbar CO₂ atmosphere, simulated typical measurement errors resulted in errors of less than 20% in the absolute density vs altitude over a wide altitude range. These preliminary results justify further study which should include the spectroscopy aspects and comparison with a planetary atmosphere absorption experiment in which a star is used as the light source and only a single flyby platform is employed.

(Author)

A67-18429

THE ATOMIC AND MOLECULAR PROCESSES IN THE UPPER ATMOSPHERES OF PLANETS.

Mikio Shimizu (Ochanomizu Women's University, Dept. of Physics, Tokyo, Japan).

Report of Ionosphere and Space Research in Japan, vol. 20, no. 3, 1966, p. 271-288. 58 refs.

Theoretical investigation of the atomic and molecular processes in the upper atmospheres of Venus, Mars, and Jupiter by using the atmospheric models recently proposed by JPL. The amount of CO molecules in the upper atmospheres of Venus and Mars may be about 2 and 0.2 cm STP respectively, provided photochemical equilibrium takes place. On both Venus and Mars, the effect of diffusion should be taken into account to determine the distribution of O₂ molecules, and the effect of the solar corpuscular stream on the upper atmospheres may be pronounced because of the lack of magnetism. On Jupiter, the molecular hydrogen and the atomic helium are first ionized and then decomposed to produce the atomic hydrogen, the ionization of which may be responsible for the formation of a dense Jovian ionosphere. The maximum electron density was found to be $1.5 \times 10^{17}/\text{cm}^3$, and the total amount of H atoms in the Jovian upper atmosphere may be 0.01 cm STP. A qualitative picture of the solar-planetary relationships based on the results of these calculations is presented.

M. F.

A67-18454 *#

RADIO OCCULTATION MEASUREMENTS OF PLANETARY ATMOSPHERES AND PLANETARY SURFACE TOPOGRAPHY.

G. Fjeldbo (Stanford Center for Radar Astronomy, Stanford, Calif.).
American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 5th, New York, N.Y., Jan. 23-26, 1967, Paper 67-119, 6 p. 14 refs.

Members, \$0.75; nonmembers, \$1.50.

Grant No. NsG-377.

The paper describes radio experiments for the study of planetary atmospheres and planetary surface topography. They require measurements of perturbations to the amplitude and frequency on the radio links between a spacecraft and the earth. The spacecraft must have a trajectory that involves occultation of the spacecraft by the planet as seen from the earth. The changes imposed on the radio links by the planetary atmosphere are used to determine the refractivity profile in altitude of the nondispersive (neutral) and dispersive (ionized) regions of the atmosphere. For moderately dense atmospheres, the radio propagation path can penetrate the atmosphere tangentially all the way down to the limb, and the time of signal extinction and commencement can be utilized to determine the radii of the occulting surface features. This was the case on Mars and is also expected to apply to Mercury. The atmospheres of Venus and Jupiter, on the other hand, may be too dense to permit tangential penetration all the way down to the surface. It may, therefore, be necessary to utilize the radio energy scattered from the surface in order to probe the lowest portion of these atmospheres.

(Author)

A67-18508

DYNAMICS OF A GUIDED PROPULSIVE SOFT LANDING PRECEDED BY A MARTIAN ATMOSPHERIC DECELERATION.

Peter J. Moonan (Grumman Aircraft Engineering Corp., Bethpage, N.Y.).

American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 5th, New York, N.Y., Jan. 23-26, 1967, Paper 67-170, 8 p.

Members, \$0.75; nonmembers, \$1.50.

A guided propulsive solution to the problem of removing the last several thousand feet per second of velocity from a Mars soft landing vehicle is presented. The propulsive phase of the trajectory starts at some point on the entry trajectory traversed by an unguided symmetrical blunt body. A gravity turn is obtained by controlling attitude so that the thrust vector is coincident with and opposite to the velocity vector. Mass flow rate is controlled so that velocity is proportional to slant range to the planet surface as measured along the thrust axis. The dynamics of the trajectory are such that path angle approaches -90° and the thrust axis approaches a vertical attitude as the trajectory progresses. Guidance and engine ignition equations are presented and a stability criterion for the guided soft landing trajectory is developed. The capability of the system to accept large variations in the preceding entry trajectory resulting from atmospheric uncertainties is demonstrated by stimulated trajectory data.

(Author)

A67-18645

FROST PHENOMENA ON MARS.

Duwayne M. Anderson, Edward S. Gaffney, and Philip F. Low (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, N.H.).

Science, vol. 155, Jan. 20, 1967, p. 319-322. 12 refs.

The hypothesis that the Martian wave of darkening might be a frost-heaving phenomenon has been examined. Consideration of the water-vapor sorption characteristics of a silicate mineral surface at temperatures below freezing leads to the conclusion that, without strongly deliquescent salts to attract and retain liquid water in the Martian soil, frost-heaving phenomena are not to be expected on Mars. On the other hand frost-heaving phenomena involving the freezing and thawing of ammonia may be common in the soils of Jupiter.

(Author)

A67-18849 *#

LAMINAR CONVECTIVE HEATING AND ABLATION IN THE MARS ATMOSPHERE.

Joseph G. Marvin and Ronald B. Pope (NASA, Ames Research Center, Moffett Field, Calif.).

(AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966, TECHNICAL PAPERS, p. 370-382.)

AIAA Journal, vol. 5, Feb. 1967, p. 240-248. 37 refs.

[For abstract see issue 13, page 2208, Accession no. A66-25274]

A67-18997

STRUCTURES OF THE TERRESTRIAL AND EXTRATERRESTRIAL ATMOSPHERES.

Israel Katz (Northeastern University, Boston, Mass.).

(New York Academy of Sciences, Conference on Planetology and Space Mission Planning, New York, N.Y., Nov. 3, 4, 1965, Paper.)
New York Academy of Sciences, Annals, vol. 140, Dec. 16, 1966, p. 49-60.

Examination of factors - such as gravitation, solar radiation, planetary rotation, emissivity, tidal effects, and magnetic fields - that affect atmospheric structures. First-order through eleventh-order structural features of the earth's atmosphere are described.

D. H.

A67-19057 ***ORGANIC MOLECULES AND THE COLORATION OF JUPITER.**

C. E. Sagan (Harvard University; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.), E. R. Lippincott (Maryland, University, Dept. of Chemistry, College Park, Md.), M. O. Dayhoff, and R. V. Eck (National Biomedical Research Foundation, Silver Spring, Md.).
Nature, vol. 213, Jan. 21, 1967, p. 273, 274. 7 refs.
 NASA-supported research.

Discussion of the simulation of the Jovian atmosphere in which a mixture of hydrogen, methane, and ammonia was supplied with energy from a corona discharge. Such simple organic molecules were produced as hydrogen cyanide, methyl cyanide, acetylene, ethylene, and ethane. Their interaction products were predicted to be brightly colored. With high local temperatures and quenching there is thought to be a wide range of pressures and temperatures in which substituted benzene rings and polycyclic aromatic compounds are formed in significant yield.

B. B.

A67-19380 #**THEORETICAL INVESTIGATION OF ENTRY VEHICLE STABILITY IN THE MARS ATMOSPHERE.**

C. L. Kyriss and H. Rie (General Electric Co., Missile and Space Div., Re-Entry Systems Dept., Theoretical Aerodynamics Div., Philadelphia, Pa.).
 (AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966, TECHNICAL PAPERS, p. 383-390.)
Journal of Spacecraft and Rockets, vol. 4, Feb. 1967, p. 272-275.
 9 refs.
 [For abstract see issue 13, page 2191, Accession no. A66-25275]

A67-20022 ***VENUS - ATMOSPHERIC EVOLUTION.**

Margaret O. Dayhoff, Richard V. Eck (National Biological Research Foundation, Silver Spring, Md.), Ellis R. Lippincott (Maryland, University, Dept. of Chemistry, College Park, Md.), and Carl Sagan (Harvard University; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).
Science, vol. 155, Feb. 3, 1967, p. 556-558. 29 refs.
 Grants No. NGR-21-003-002; No. NGR-21-002-059; No. NGR-09-015-023.

Computation of the thermodynamic equilibrium composition of the atmosphere of Venus from the atomic composition deduced spectroscopically. It is found that there can be no free carbon, hydrocarbons, formaldehyde, or any other organic molecule present in more than trace amounts. The original atomic composition of the atmosphere must have included much larger quantities of hydrogen and a carbon/oxygen ratio ≤ 0.5 . The present atomic proportions of the atmosphere of Venus are so unique that an evolutionary mechanism involving two independent processes seems necessary. Water, originally present in large quantities, has been photodissociated in the upper atmosphere, and the resulting atomic hydrogen has been lost in space. The resulting excess oxygen has been very effectively bound to the surface materials.

M.F.

A67-20623 ***FLIGHT DYNAMICS OF PLANETARY ENTRY.**

Rodney C. Wingrove (NASA, Ames Research Center, Moffett Field, Calif.).

IN: RECENT DEVELOPMENTS IN SPACE FLIGHT MECHANICS; AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND AMERICAN ASTRONAUTICAL SOCIETY, SPECIAL ASTRONAUTICS SYMPOSIUM, BERKELEY, CALIF., DECEMBER 29, 1965, PROCEEDINGS.

Symposium sponsored by the Space Flight Mechanics Committee of the American Astronautical Society.
 Edited by P. B. Richards.

Tarzana, Calif., American Astronautical Society (AAS Science and Technology Series. Volume 9), 1966, p. 225-268. 49 refs.

Review of both ballistic and lifting vehicle entries into the planetary atmospheres of Mars, the earth, Venus, and Jupiter.

Approximate equations are used in discussing the entry trajectory dynamics and in presenting a few of the more important entry trajectory problems in future space missions. The entry of unmanned ballistic probes into the atmosphere of Mars is considered, and a soft landing on the surface of Mars is shown to be marginal for the low surface pressures that are currently estimated. For ballistic entries at Venus and Jupiter, high aerodynamic deceleration forces are to be expected. For the entry of manned lifting vehicles into planetary atmospheres, it is shown that a "capture" maneuver must be performed to keep the vehicle from exceeding aerodynamic load limits or from skipping back out of the atmosphere.

M.F.

A67-20931 ***ANISOTROPIC NONCONSERVATIVE SCATTERING AND THE CLOUDS OF VENUS.**

Carl Sagan (Harvard University; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.) and James B. Pollack (Smithsonian Institution, Smithsonian Astrophysical Observatory; Harvard University, Harvard College Observatory, Cambridge, Mass.).
Journal of Geophysical Research, vol. 72, Jan. 15, 1967, p. 469-477.
 20 refs.

Grant No. NGR-09-015-023.

Expressions have been obtained in a modified Schuster-Schwarzschild approximation describing the monochromatic transmissivity, reflectivity, and absorptivity of a cloud layer characterized by an arbitrary single-scattering albedo and anisotropic phase function. These analytic results for fluxes are accurate to within a few percent when compared with a range of exact solutions for limiting cases, including the case of strong forward scattering and large optical depth. The application of this formalism, combined with exact solutions of the Mie theory problem, to the observed visual and near-IR reflectivity of Venus permits the determination of a number of properties of the Venus cloud layer. Strong's identification of ice as the principal constituent of the clouds is confirmed. Liquid water, hydrocarbons, and dust are found to be unlikely principal constituents of the cloud tops. In addition, the mean radius of cloud particles lies between 7.5 and 10 μ , and the interaction optical depth of the layer is between 18 and 43 μ . Clouds having these properties allow a sizable fraction of the incident sunlight to penetrate to the surface but are extremely opaque to radiation thermally produced by the planet.

(Author)

A67-21155 ***ON ENTERING AN ALIEN ATMOSPHERE.**

Alvin Seiff (NASA, Ames Research Center, Vehicle Environment Div., Moffett Field, Calif.).
New Scientist, vol. 32, Dec. 29, 1966, p. 730-732.

Outline of the main problems associated with entry into the atmospheres of other planets. Because knowledge of planetary atmospheres is incomplete, it is difficult to design for heating, stressing, and landing conditions of the vehicle. Furthermore, the velocity of entry is in some cases far above that experienced in bringing vehicles back to earth - and this requires an extension of technology. For Mars and Mercury, low atmospheric densities make it difficult to slow the vehicle for a landing.

F.R.L.

A67-21213**COMPARISONS OF LABORATORY AND PLANETARY SPECTRA. IV.**

Tobias Owen (IIT Research Institute, Chicago, Ill.; Arizona, University, Lunar and Planetary Laboratory, Tucson, Ariz.).
Icarus, vol. 6, Jan. 1967, p. 108-113. 10 refs.
 Contract No. NRO-46-791.

Discussion of spectra of Uranus which have revealed several new absorptions in addition to the five unidentified features near 7500 \AA previously discovered by Kuiper in the spectra of Uranus and Neptune. Laboratory spectra obtained with very long optical paths indicate that all these planetary absorptions are caused by methane. This result suggests that the amount of methane in the atmospheres of Uranus and Neptune is greater than presently accepted estimates.

F.R.L.

A67-21215

THE RELATIONSHIP BETWEEN TERRESTRIAL AND JOVIAN ATMOSPHERIC CIRCULATIONS [SUR LA PARENTE DES CIRCULATIONS ATMOSPHERIQUES TERRESTRE ET JOVIENNE], F. Link (Československá Akademie Věd, Astronomický Ústav, Ondřejov, Czechoslovakia).

Icarus, vol. 6, Jan. 1967, p. 129-131. 5 refs. In French.

Comparison of terrestrial and Jovian atmospheric circulations by study of the motion of the red spot of Jupiter between 1831 and 1940, and of the curve of the discovery of comets, which is affected by night cloudiness. Simultaneous variations in the two circulations have been observed. It is considered that the common cause must be sought in solar activity. F. R. L.

A67-21218

ON THE ABUNDANCE OF ETHANE IN THE ATMOSPHERES OF JUPITER AND SATURN.

Tobias Owen (IIT Research Institute, Chicago, Ill.).

Icarus, vol. 6, Jan. 1967, p. 138-140. 5 refs.

Reinvestigation of observational evidence for the existence of ethane in the atmospheres of Jupiter and Saturn. Results were largely negative, and it is concluded that the IR observations are consistent in revealing no trace of the presence of ethane in the atmospheres of either planet. The upper limit is still rather crude compared with amounts which might be expected to be present as a result of nonequilibrium reactions. F. R. L.

A67-21250

A DETERMINATION OF THE MARTIAN CO₂ ABUNDANCE.

Edwin S. Barker (Texas, University, Dept. of Astronomy, Austin, Tex.).

Astrophysical Journal, vol. 147, Jan. 1967, p. 379-381.

Account of a completely independent reduction of 1965 spectroscopic data on the CO₂ abundance and surface pressure of Mars performed because of the partially subjective element which must enter into the spectroscopic methods, if only from the estimation of the continuum. The reductions were made on the set of plates by Spinrad et al. The abundance reductions, using reflected Fraunhofer lines to calibrate the tracings, were the primary purpose of this investigation. The pressure calculations depend on the methods and data given by Kaplan, Munch, and Spinrad and Owen and Kuiper for the saturated 2.0- and 1.6- μ bands, respectively. These calculations contain the revision of the self-broadening correction to the effective surface pressure that was indicated by Spinrad et al. Sources of error and causes of the discrepancies found are examined. M. M.

A67-21372 *

A NOTE ON THE POSSIBLE CONTRIBUTION OF DIELECTRIC RELAXATION IN GASES TO THE MICROWAVE OPACITY OF THE CYTHEREAN ATMOSPHERE.

Lothar Frenkel (NASA, Electronics Research Center, Cambridge, Mass.).

Planetary and Space Science, vol. 15, Jan. 1967, p. 204, 205. 5 refs.

Study attempting to explain the sharp rise of the absorption coefficient of the Cytherean atmosphere in the vicinity of 30 GHz (1 cm⁻¹). It is pointed out that the observed phenomenon can be produced by an effect observed in a planetary atmosphere at moderate pressures, namely, that in addition to their rotation spectra, symmetrical top molecules exhibit a dielectric (Debye) relaxation so that the absorption coefficient of such gases and their mixtures with nonpolar gases in the microwave region are very high. M. F.

A67-21991 *

RESPONSE OF FUNGI TO DIURNAL TEMPERATURE EXTREMES.

Charles R. Curtis (NASA, Ames Research Center, Exobiology Div., Moffett Field, Calif.).

Nature, vol. 213, Feb. 18, 1967, p. 738, 739. 6 refs.

Description of the results of a preliminary investigation of the response of various fungi to diurnal temperature extremes of -94 and 23 \pm 2°C. The fungi were grown on malt agar (BBL), and two

or four agar disks 10 mm in diameter were transferred to Petri dishes containing a sterilized soil mix. In those species of fungi that survived the exposure to diurnal temperature extremes but did not grow, growth on the agar plug may have occurred but was so limited that it was not detected. Data indicated, however, that certain fungi were able to survive and produce limited mycelial growth when exposed to simulated Martian diurnal temperature extremes. Although most of the hyphae and spores were probably killed after the first few cycles, resistant portions apparently succeeded in growing and adapting to this temperature regime. M. M.

A67-22016 *

MERCURY - NEW OBSERVATIONS OF THE INFRARED BANDS OF CARBON DIOXIDE.

Alan B. Binder and Dale P. Cruikshank (Arizona, University, Lunar and Planetary Laboratory and Dept. of Geology, Tucson, Ariz.).

Science, vol. 155, Mar. 3, 1967, p. 1135.

Grant No. NSG-161-61.

Application of a 61-in. reflector and of an IR spectrometer to the study of the 1.6- μ bands of CO₂ in the spectrum of Mercury on Aug. 26, 1966. From the observations made, the equivalent widths of the 1.57- and 1.61- μ bands were found to be 12.5 ± 1.9 and 10.0 ± 2.3 Å, respectively; while for the solar comparisons the equivalent widths are 12.4 ± 0.7 and 10.5 ± 0.8 Å. Thus, within the error of the observations, there is no evidence of a carbon dioxide atmosphere on Mercury. M. F.

A67-22235 *

HIGH-DISPERSION SPECTROSCOPIC OBSERVATIONS OF MARS. II.

Ronald A. Schorn (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.), Hyron Spinrad, Lawrence P. Giver (California, University, Dept. of Astronomy, Berkeley, Calif.), Roger C. Moore (RAND Corp., Santa Monica, Calif.), and Harlan J. Smith (Texas, University, McDonald Observatory, Fort Davis, Tex.).

Astrophysical Journal, vol. 147, Feb. 1967, p. 743-752. 17 refs. NASA-supported research; Grant No. Nonr(G)-00006-66; Contract No. AF 49(638)-1700.

Nineteen high-dispersion spectrograms of Mars taken at McDonald and Lick Observatories during the 1964-1965 apparition have been examined for Doppler-shifted rotational lines of H₂O near $\lambda 8200$. The presence of H₂O in the atmosphere of Mars appears to be confirmed, but indications are that its concentration varies with time and location on the planet. Typical amounts of H₂O are of the order of 10-20 μ precipitable water vapor. The spectroscopic results are compared with photographic patrol studies during this apparition. The amount of water in the vapor phase seems to depend upon the size of the Martian polar cap, implying a physical connection between the two. (Author)

A67-22236 *

THERMODYNAMIC EQUILIBRIA IN PLANETARY ATMOSPHERES.

Ellis R. Lippincott (Maryland, University, Dept. of Chemistry, College Park, Md.), Richard V. Eck, Margaret O. Dayhoff (National Biomedical Research Foundation, Silver Spring, Md.), and Carl Sagan (Harvard University; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).

Astrophysical Journal, vol. 147, Feb. 1967, p. 753-764. 35 refs.

NASA Contract No. 21-003-002; NASA Grant No. 21-002-059; Grant No. NGR-09-015-023.

The thermodynamic equilibrium composition of all possible combinations of the elements carbon, hydrogen, oxygen, and nitrogen at average pressures and temperatures have been calculated for the atmospheres of Earth, Venus, Mars, and Jupiter. All regions of the composition diagram consistent with the observed molecular abundances are located and discussed. The constituents of the terrestrial atmosphere considered as a closed system are in approximate thermodynamic equilibrium in spite of the continual addition of trace compounds by biological activity, lightning, radiation, and vulcanism. Under some circumstances, the presence of atmospheric organic molecules far in excess of their thermodynamic equilibrium proportions can be an indication of indigenous biological

activity. The atmosphere of Venus seems likely to be in thermodynamic equilibrium. It then follows that the measured upper limits on the abundances of CH_4 , NH_3 , and CO are all inconsistent with the possibility of elemental carbon or hydrocarbons in contact with the atmosphere, either on the surface or as clouds. The evidence for Mars is not inconsistent with thermodynamic equilibrium. The computations do not indicate whether small quantities of free O_2 exist. The equilibrium abundances of all oxides of nitrogen on Mars are extremely low even if computed with a considerable excess of O_2 . For Mars and Venus there are no molecular species with a large predicted equilibrium abundance and spectroscopically accessible absorption features which have not already been identified. Under equilibrium conditions at low temperatures Jupiter also cannot contain significant amounts of any molecule not yet observed. However, at high temperatures such as would be produced by lightning discharges or in the Jovian thermosphere, simple hydrocarbons and cyanides, polycyclic aromatics, and a variety of nitrogen compounds would be expected. Some of these compounds are brightly colored, and it seems possible that such organic compounds contribute to the observed variable coloration of Jupiter. (Author)

A67-22237

MODEL ATMOSPHERES OF THE MAJOR PLANETS.

L. M. Trafton (Carnegie Institution of Washington and California Institute of Technology, Mount Wilson and Palomar Observatories, Pasadena, Calif.).

Astrophysical Journal, vol. 147, Feb. 1967, p. 765-781. 39 refs.

Nongray model atmospheres have been constructed for the major planets assuming and introducing first-order radiative-equilibrium corrections to account for convection. The thermal opacity was provided by the pressure-induced absorption of H_2 and also by its enhancement resulting from mixing with He. The thermal opacity due to NH_3 was found to be negligible in all of the major planets except Jupiter, where the effect is but minor. In constructing the models, the He/H_2 abundance ratios and effective temperatures were considered free parameters to be determined by fitting the models to the observations. In all the models the absorption is strong enough to bring about convection in the deeper layers. In the case of the Jovian models, the amount of H_2 lying above the convective zone is found to be approximately equal to the observed amount lying above the planet's visual cloud layer. The Jovian limb darkening in the 8-14- μ region can be explained in terms of absorption due to H_2 , He, and the 10- μ band of NH_3 but cannot be explained when the NH_3 band is excluded. Models of Jupiter for which only the thermal opacity of H_2 and NH_3 are taken into account are incompatible with the observations. Adding He, however, eliminates this incompatibility, indicating that He is present in these atmospheres. In the case of Jupiter, a rather large He/H_2 value is implied if there is no internal heat source. However, the observations suggest that the value of He/H_2 is less than 2 so that the existence of a small internal heat source generating more than one-tenth of the incident solar flux is implied. (Author)

A67-22240 *

ON THE LIMB DARKENING OF PLANETARY ATMOSPHERES IN THE THERMAL INFRARED.

R. E. Samuelson (NASA, Goddard Space Flight Center, Greenbelt, Md.).

Astrophysical Journal, vol. 147, Feb. 1967, p. 810-815. 9 refs.

Demonstration of how exact solutions to the problem of describing the angular distribution of outgoing radiation from a slab of material bounded on both sides by a vacuum may be expressed in terms of Chandrasekhar's ψ - and Φ -functions of zero order when both scattering and temperature-gradient effects are present. Values representing the phase function for single scattering representative of a flat particle-size distribution covering the range $0 \leq d \leq 12.73 \mu$ are plotted. B.B.

A67-22715

SELF-BROADENING EFFECTS IN THE INFRARED BANDS OF GASES.

A. Anderson, An-Ti Chai, and Dudley Williams (Kansas State University of Agriculture and Applied Science, Dept. of Physics, Manhattan, Kan.).

Optical Society of America, Journal, vol. 57, Feb. 1967, p. 240-246. 17 refs.

USAF-supported research.

Various techniques for measurement of the self-broadening of spectral lines of absorbing gases as compared with the line-broadening effects of nitrogen were tested and are critically compared. Mean values of self-broadening coefficients applicable to entire absorption bands were redetermined with improved precision for CO , CO_2 , N_2O , CH_4 , and NH_3 ; agreement with earlier results is good except for NH_3 . Low-resolution studies of the variation of self-broadening coefficients across absorption bands indicate that the coefficients generally have maximum values in the spectral regions where absorption is greatest; however, the coefficients for individual vibration-rotation lines determined at higher resolution do not, in general, show striking variations from line to line in a given band. Certain apparent anomalies in the results for NH_3 are discussed. (Author)

A67-22768 *

ATMOSPHERE DEFINITION WITH A FREE-FALLING PROBE.

Simon C. Sommer and Alfred G. Boissevain (NASA, Ames Research Center, Moffett Field, Calif.).

Astronautics and Aeronautics, vol. 5, Feb. 1967, p. 50-54. 7 refs.

Experimental confirmation of the ability of a free-falling probe during terminal descent to draw an accurate profile of an unknown planetary atmosphere from onboard measurements alone. A small instrumented capsule was carried by balloon to an altitude of 130,000 ft over White Sands Missile Range, N. Mex. During free fall, the capsule accelerated almost to sonic velocity in a density regime similar to that expected near the surface of Mars. This experiment showed that atmospheric and altitude measurements can be made with good accuracy. At flight velocities approaching sonic speeds, ambient pressures and temperatures can be obtained from the acceleration history of the vehicle and from local pressure and temperature measurements, and the average molecular weight of the gas can be deduced from these measurements as well. F.R.L.

A67-22957

SURFACE PRESSURES IN THE MARTIAN HIGHLANDS AND LOWLANDS.

J. Otterman (Tel-Aviv University, Institute of Planetary and Space Science, Ramat-Aviv, Israel).

Nature, vol. 213, Mar. 11, 1967, p. 1000, 1001. 13 refs.

Discussion of elevation of the Martian dark areas (maria) relative to the bright areas (deserts). Various theories of Wells (1966), Sagan (1966), Miyamoto (1966), Tombaugh (1966), and Fjeldbo (1966) are treated briefly. The lack of whitening in the maria area is noted, and a hypothesis for such an observation is given. Pressure data gathered from the Mariner 4 mission are reviewed. The possibility that pressure and temperature may be higher in the highland areas than in the lowland areas is examined. R.B.S.

A67-24063 *

DETECTING PLANETARY LIFE FROM EARTH.

Dian R. Hitchcock (United Aircraft Corp., Hamilton Standard Div., Biosciences Section, Windsor Locks, Conn.), Peter Fellgett (Reading, University, Dept. of Applied Physical Sciences, Reading, Berks., England), Janine Connes (Centre National de la Recherche Scientifique, Service d'Aéronomie, Observatoire de Meudon, Meudon, Seine-et-Oise, France), Pierre Connes (Centre National de la Recherche Scientifique, Bellevue, Seine-et-Oise, France), Lewis D. Kaplan (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.), J. Ring (Hull, University, Hull, Yorks., England), and J. E. Lovelock. *Science Journal*, vol. 3, Apr. 1967, p. 56-67.

Discussion of new techniques which make possible the detection of extraterrestrial life from the earth's surface. The development

A67-24501

of such methods has led to the proposed construction of the world's largest telescope to investigate any possible modification of planetary atmospheres by life. The genesis of multiplex spectrometry and its application to planetary atmospheres is considered, and ways of interpreting the observations are outlined. The construction of a 1000 in. telescope is detailed, and a diagram is given which summarizes the angular resolving power and sizes of some large radio and optical telescopes.

B.B.

A67-24501

SOME COMMENTS ON MARTIAN WHITE CLOUDS.

R. A. Wells (London, University, Observatory, Mill Hill, Middx., England).

Astrophysical Journal, vol. 147, Mar. 1967, p. 1181-1183. 5 refs.

Discussion of a scientific note and a related article to support suggestions that the mass motion of H_2O in the atmosphere of Mars appears to be correlated with polar cap recession and growth, and possibly with the frequency of appearance of white clouds and identification of dark features on the surface. The scientific note contains a correlation between the white-cloud frequency, which shows a bimodal distribution, and the waxing and waning of the polar caps. This correlation is based on the observation that the ratio of maximum mass transfer from both polar caps is equal to the ratio of the two maximum cloud frequencies. The cloud frequencies were determined from 253 observations derived from the literature, polarization studies, and photographs.

M.M.

A67-24510 *

TRACES OF HCl AND HF IN THE ATMOSPHERE OF VENUS.

P. Connes (Centre National de la Recherche Scientifique, Bellevue, Seine-et-Oise, France), J. Connes (Centre National de la Recherche Scientifique, Service d'Aéronomie, Observatoire de Meudon, Meudon, Seine-et-Oise, France), W. S. Benedict (Johns Hopkins University, Baltimore, Md.), and L. D. Kaplan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
Astrophysical Journal, vol. 147, Mar. 1967, p. 1230-1237. 15 refs. USAF-supported research.

Discussion of Venus spectra obtained with a Michelson interferometer designed for high-resolution planetary infrared spectroscopy. Three atmospheric windows, corresponding to 3900 to 5300 cm^{-1} , 5500 to 7200 cm^{-1} , and 7600 to 8500 cm^{-1} were isolated by interference filters. Narrow absorption lines are detected and assigned to the 2-0 vibration-rotation band of HCl and the 1-0 and 2-0 bands of HF. The HCl lines are consistent with 2-mm Amagat of the gas in the optical path, at temperature near 240°K and pressure near 0.1 atm, in a spectral region where the effective CO_2 path is 1.7×10^6 times as large. The less intensive HF data indicate about 0.02 mm Amagat of that gas.

V.P.

A67-24601

THE MICROWAVE SPECTRUM OF VENUS IN THE FREQUENCY RANGE 18-36 GC/SEC.

P. H. Griffith, D. D. Thornton, and W. J. Welch (California, University, Space Sciences Laboratory and Radio Astronomy Laboratory, and Dept. of Electrical Engineering, Berkeley, Calif.).
Icarus, vol. 6, Mar. 1967, p. 175-188. 27 refs.

The microwave emission from Venus was measured at seven frequencies in the interval 18 to 36 Gc in July 1964 shortly after inferior conjunction. The resulting spectrum shows a fairly smooth but rapid decrease in the planet's brightness toward the higher frequencies. The measurements are compared with the spectra of several model atmospheres which contain CO_2 , N_2 , water vapor, liquid water clouds, and high dust or ice clouds. None of the model spectra exactly fit all the present measurements. A best fit for the model in which absorption is due to CO_2 and N_2 requires a surface pressure of about 200 atm. A best fit for the model which contains, in addition, water vapor and liquid water clouds requires about 12 gm/cm² of the vapor and 0.06 gm/cm² of liquid water clouds at a temperature of 240°K. The best agreement is provided by a model which contains scattering particles. For dust particles of mean diameter 0.3 mm and dielectric constant 5, the required number of particles is $2.5 \times 10^6/cm^2$.

(Author)

A67-24843

NATURE OF VENUS [PRIRODA VENERY].

V. A. Bronshten (Vsesoiuznoe Astronomo-Geodezicheskoe Obshchestvo, USSR).

Astronomicheskii Vestnik, vol. 1, Jan.-Mar. 1967, p. 4-27. 104 refs. In Russian.

Review of the current status of our knowledge on the surface and atmosphere of the planet Venus, on the basis of recent radar, radioastronomic, and IR spectroscopic observations. General data on Venus are examined, including dimensions, mass, rotation, illumination, heating, magnetic field, and radiation belts. A discussion of the surface data includes the brightness temperature, polarization, radio emission, the temperature distribution over the planet disk, and the physicochemical properties. The chemical composition of the Venus atmosphere is examined, together with the equations and initial data employed in the construction of atmospheric models.

V.P.

A67-25204 *

STIMULATION OF JUPITER'S RADIO EMISSION BY IO.

L. Marshall (Colorado, University, Dept. of Physics, Boulder, Colo.) and W. F. Libby (California, University, Dept. of Chemistry and Institute of Geophysics, Los Angeles, Calif.).
Nature, vol. 214, Apr. 8, 1967, p. 126-128. 24 refs. AEC-USAFA-NASA-supported research.

Discussion of variations in the decameter radio signals from Jupiter associated with the planet's five satellites. It is seen that Io travels in the analog of the inner Van Allen radiation belt surrounding Jupiter, giving rise to a plasma wake which streams ahead of it by about 130,000 km and stimulates the radio emission from the Jovian atmosphere.

M.F.

A67-25206 *

MAGNETOSPHERE OF JUPITER.

J. A. Gledhill (NASA, Goddard Space Flight Center, Laboratory for Space Sciences, Planetary Ionospheres Branch, Greenbelt, Md.).
Nature, vol. 214, Apr. 8, 1967, p. 155, 156. NASA-supported research.

Determination of the maximum number density of the plasma in the equatorial plane of Jupiter by equating the magnetic and rotational kinetic energy densities. Using an Angerami- and Thomas-type method, the distribution of plasma along the line of force L is calculated. Numerical calculations lead to a magnetospheric model of Jupiter. It is noted that all four of the "sources" related to Io on Jupiter appear to correlate, at least qualitatively, with the model.

M.F.

A67-25232 *

THE VOYAGER PROGRAM.

Edgar M. Cortright (NASA, Washington, D.C.).
American Astronautical Society, Goddard Memorial Symposium, 5th, Washington, D.C., Mar. 14, 15, 1967, Paper. 37 p.

Review of the Voyager project, covering goals of the Saturn-launched orbiter/lander mission to Mars, such as planetary, atmospheric, and environmental studies. Orbital operations, capsule descent, navigational systems, capsule description, and illustrations of projected goals are also treated.

R.B.S.

A67-25685 *

THE ATMOSPHERE OF MARS - A DERIVATION OF PARAMETERS FOR ENGINEERING AND DESIGN APPLICATIONS.

George S. West, Jr. and W. T. Roberts (NASA, Marshall Space Flight Center, Aero-Astrodynamic Laboratory, Aerospace Environment Div., Space Environment Branch, Huntsville, Ala.).
IN: INSTITUTE OF ENVIRONMENTAL SCIENCES, ANNUAL TECHNICAL MEETING, 13TH, WASHINGTON, D.C., APRIL 10-12, 1967, PROCEEDINGS. VOLUME 1.
Mt. Prospect, Ill., Institute of Environmental Sciences, 1967, p. 121-125. 12 refs.

Study of three models of the Martian atmosphere of differing atmospheric composition, surface pressure, and surface temperature. The molecular composition of the Martian atmosphere is discussed and the atmospheric temperature is studied. A description of the three models - the upper density model, the mean density model, and the lower density model - is given. M.F.

A67-25715 *

THE MARS TRANSIT AND ENTRY ENVIRONMENT - A NEW PROBLEM FOR HEAT SHIELDS.

Robert G. Nagler (California Institute of Technology, Jet Propulsion Laboratory, Materials Section, Pasadena, Calif.).
IN: INSTITUTE OF ENVIRONMENTAL SCIENCES, ANNUAL TECHNICAL MEETING, 13TH, WASHINGTON, D. C., APRIL 10-12, 1967, PROCEEDINGS. VOLUME 2.
Mt. Prospect, Ill., Institute of Environmental Sciences, 1967, p. 443-455. 17 refs.

Consideration of the problems introduced by landing an unmanned vehicle on the surface of Mars, with reference to some new problems in heat shield technology. The transit and entry environments experienced by such a vehicle from prelaunch to parachute deployment are outlined, with discussion of the implications of the sterilization, launch, interplanetary transit, and atmospheric entry environments on the selection of heat shield materials for various missions. Some of the NASA programs now in progress to screen the available composites in these environments are also outlined. F. R. L.

A67-25986 *

MICROWAVE METHOD FOR PLANETARY ATMOSPHERE RESEARCH.

L. Frenkel (NASA, Electronics Research Center, Cambridge, Mass.).

Review of Scientific Instruments, vol. 38, Apr. 1967, p. 557, 558.

Brief outline of the use of very high Q Fabry-Pérot microwave cavities for the study of planetary atmospheres under ambient conditions. The instrument proposed - similar to one described by Valkenburg and Derr, 1966 - for such a study is described. The use of the instrument in a problem concerning the determination of the water vapor content of an atmosphere consisting of N_2 at a pressure of about 10 mm Hg is treated. R.B.S.

A67-26009 *

DETERMINATION OF MARS ATMOSPHERIC COMPOSITION BY SHOCK-LAYER RADIOMETRY DURING A PROBE EXPERIMENT.

Ellis E. Whiting (NASA, Ames Research Center, Moffett Field, Calif.).
American Institute of Aeronautics and Astronautics, Thermophysics Specialist Conference, New Orleans, La., Apr. 17-20, 1967, Paper 67-293, 7 p. 19 refs.

Members, \$0.75; nonmembers, \$1.50.

Examination of the feasibility and accuracy of determining atmospheric composition by a shock-layer radiometer experiment on a Mars probe. In concept, a few narrow band-pass radiometers on board the entry probe would view the shock layer through a small quartz window on the probe axis of symmetry and measure the radiation emitted by selected atomic and molecular species in the shock layer. Various mixtures of CO_2 , N_2 , and A were used to simulate the Martian atmosphere. Experimental shock-layer spectra from ballistic-range tests show that CN(violet), C_2 (Swan), C (2478 Å), and O (7775 Å) are the most prominent features in the gas-cap spectrum for these gas mixtures. A theoretical study of equilibrium intensities emitted by CN(violet) and C_2 (Swan) behind a normal shock wave at Mars entry trajectory conditions shows that the relative CO_2 - N_2 -A concentrations in the ambient gas can be determined with reasonable accuracy by this technique. (Author).

A67-26038 *

EXPERIMENTAL AND THEORETICAL STUDY OF MOLECULAR, CONTINUUM, AND LINE RADIATION FROM PLANETARY ATMOSPHERES.

W. A. Menard, G. M. Thomas (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and T. M. Helliwell (Harvey Mudd College, Claremont, Calif.).

American Institute of Aeronautics and Astronautics, Thermophysics Specialist Conference, New Orleans, La., Apr. 17-20, 1967, Paper 67-323, 16 p. 62 refs.

Members, \$0.75; nonmembers, \$1.50.

Study of the various sources of equilibrium radiation important to planetary entry problems. Shock tube measurements of the radiation from a mixture of 30% CO_2 -40% N_2 -30% A were made over the temperature range 7000-16,000°K. Several approximate theoretical models for the molecular band structure are presented. These models are then compared with the results of spectral measurements of the CN violet band system. The best fit to the data is obtained using a CN dissociation energy of 7.7 ev. Calculations were made of the free-free and free-bound continua of singly ionized N, C, A, and O atoms, using nonhydrogenic cross sections, and the electron attachment continua of neutral N, O, and C atoms, using measured cross sections. Self-absorption was accounted for in the calculation of atomic line radiation by using a statistical model that considers overlapping of the individual lines. Total radiation in the region 0.3 to 2.7 μ was measured at the stagnation point of a flat-faced cylinder model. Comparison of the theoretical predictions with the data suggests that an unknown source, which was not included in the calculations, may be present. (Author)

A67-26244 *

ON THE POLARIMETRIC EVIDENCE FOR AN ATMOSPHERE ON MERCURY.

B. T. O'Leary and D. G. Rea (California, University, Space Sciences Laboratory, Berkeley, Calif.).

Astrophysical Journal, vol. 148, pt. 1, Apr. 1967, p. 249-253. 12 refs. Grant No. NSG-101-61.

Discussion of Dollfus' conclusion of several years ago that Mercury has an atmosphere from observations of excess polarization values at shorter wavelengths and at the cusps with respect to the center. It is noted that this conclusion depended on various assumptions regarding the polarimetric properties of Mercury and the moon. However, in view of recent lunar and laboratory data which show the same excess polarization both in color and location, these assumptions are found to be incorrect or inapplicable. It follows that the polarization properties of Mercury can be explained by its surface only, so there is no polarimetric evidence for an atmosphere on Mercury. The polarimetric observations suggest an upper limit of 1 mb for the surface pressure, while the similarity of the polarimetric and photometric properties of Mercury and the moon suggests an upper limit of 10^{-5} mb. M.M.

A67-26316

SPHERICAL PARTICLE TERMINAL VELOCITIES IN THE MARTIAN DAYTIME ATMOSPHERE FROM 0 TO 50 KILOMETERS.

Albert D. Anderson (Lockheed Aircraft Corp., Lockheed Missiles and Space Co., Research Laboratories, Palo Alto, Calif.).

Journal of Geophysical Research, vol. 72, Apr. 1, 1967, p. 1951-1958. 12 refs.

Research supported by the Lockheed Independent Research Program.

Presentation of the terminal velocities of spherical particles (density = 30 g/cm³), with diameters from 1 to 10,000 μ , for three Martian daytime model atmospheres from 0 to 50 km, based on two different surface pressures (5.55 and 10 mb). The model atmospheres are founded on results from the Mariner 4 occultation experiment, which gave densities in the Martian atmosphere that were much lower than previous estimates. The following conclusions are reached concerning the yellow (dust) clouds: (1) the vertical velocities required to keep yellow-cloud particles of sizes 10 μ or less aloft are greater on Mars than on earth. (2) The minimum size of the grains primarily responsible for the local surface yellow-cloud obscurations is about 20 μ . This falls within the range of estimates in the literature (1-20 μ) as to the size primarily responsible for the

surface obscurations. (3) Particles as small as 3μ could be responsible for the rarer planet-wide obscurations lasting a month or more. The above conclusions are compared with those of Ryan who based his analysis on a denser Martian model atmosphere (25 mb).
(Author)

A67-26819 * #**RADIO OCCULTATION INVESTIGATIONS OF THE ATMOSPHERE OF MARS.**

Arvydas Kliore and Dennis A. Tito (California Institute of Technology, Jet Propulsion Laboratory, Systems Analysis Section, Pasadena, Calif.).
(AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND AMERICAN ASTRONAUTICAL SOCIETY, STEPPING STONES TO MARS MEETING, BALTIMORE, MD., MARCH 28-30, 1966, TECHNICAL PAPERS, p. 5-13.)
Journal of Spacecraft and Rockets, vol. 4, May 1967, p. 578-582. 9 refs.
[For abstract see issue 13, page 2178, Accession no. A66-25235]

A67-27333 #**DISTRIBUTION OF THE RADIO-BRIGHTNESS TEMPERATURE OVER THE DISK OF VENUS [O RASPREDELENII RADIOIARKOSTNOI TEMPERATURY PO DISKU VENERY].**

A. G. Pavel'ev and G. M. Strelkov.
Kosmicheskie Issledovaniia, vol. 5, Mar.-Apr. 1967, p. 265-275. 26 refs. In Russian.

Determination of the distribution of the radio-brightness temperature over the disk of Venus at the wavelengths of 1.9 and 1.35 cm for a spherically symmetrical model of the Venus atmosphere. This distribution is determined from the results of a scanning of Venus at these wavelengths by Mariner 2 during its fly-by in December 1962. The distribution of the brightness temperature averaged over the radiation pattern of the on-board antenna of Mariner 2 is also determined.
A. B. K.

A67-27462 #**DISCRETE EQUILIBRIUM TEMPERATURES OF A HYPOTHETICAL PLANET WITH THE ATMOSPHERE AND THE HYDROSPHERE OF ONE-COMPONENT TWO-PHASE SYSTEM UNDER CONSTANT SOLAR RADIATION.**

M. Komabayasi (Nagoya University, Water Research Laboratory, Nagoya, Japan).
Meteorological Society of Japan, Journal, vol. 45, Feb. 1967, p. 137-139. 10 refs.

Qualitative consideration of the thermal equilibrium states of the ocean and of the vapor atmosphere of a planet by use of a model of a one-component two-phase system. The obtained result is expected to suggest the existence of a few discrete temperature levels in equilibrium on a real planet which has a vast ocean under a constant solar radiation.
T. M.

A67-27859**THE GREENHOUSE EFFECT IN THE ATMOSPHERE OF VENUS.**

G. M. Strelkov.
(Kosmicheskie Issledovaniia, vol. 4, July-Aug. 1966, p. 581-591.)
Cosmic Research, vol. 4, July-Aug. 1966, p. 514-522. 24 refs. Translation.
[For abstract see issue 22, page 3980, Accession no. A66-40469]

A67-28959**GENERAL SURVEY OF PLANETS [PRESENTATION D'ENSEMBLE DES PLANETES].**

M. Tardi.
(Société Française d'Astronautique, Journée sur l'Exploration des Planètes, Roquencourt, Seine-et-Oise, France, Dec. 1, 1966, Exposé.)
Revue Française d'Astronautique, Mar. 1967, p. 4-12. In French.
Summary of current knowledge concerning the solar system. The principal characteristics of the planets of the solar system are

summarized, and a number of findings are cited concerning planetary temperatures, dissipation of planetary atmospheres, and the internal structure of planets.
M. M.

A67-28964**DIRECT SOUNDING OF THE ATMOSPHERE OF PLANETS [SONDAGE DIRECT DE L'ATMOSPHERE DES PLANETES].**

G. Israel (Centre National de la Recherche Scientifique, Service d'Aéronomie, Verrières-le-Buisson, Seine-et-Oise, France).
(Société Française d'Astronautique, Journée sur l'Exploration des Planètes, Roquencourt, Seine-et-Oise, France, Dec. 1, 1966, Exposé.)

Revue Française d'Astronautique, Mar. 1967, p. 31-34. In French.
Results of direct observations of the atmosphere of planets made by means of Mariner 2. The measurement of the brightness temperature of the emitting regions of Venus and of its atmosphere is discussed, together with the direct sounding of the Martian atmosphere. Regarding the magnetic field of Mars, the measurements of Mariner 2 show the field to be only 1/1000th or 5/10,000th of the earth's magnetic field, pointing to the possibility of direct interaction with the solar wind.
M. M.

A67-29098 ***A DISCUSSION OF THE PLANETARY QUARANTINE CONSTRAINTS.**

J. O. Light, C. W. Craven (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), W. Vishniac (Rochester University, Rochester, N.Y.), and L. B. Hall (NASA, Washington, D.C.).

(COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-18, 1966, Paper.)

IN: LIFE SCIENCES AND SPACE RESEARCH V; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research, the International Union of Biochemistry, the International Union of Biological Sciences, and the International Union of Physiological Sciences.

Edited by A. H. Brown and F. G. Favorite.

Amsterdam, North-Holland Publishing Co., 1967, p. 7-21.

[For abstract see issue 15, page 2441, Accession no. A66-29966]

A67-30628**SYSTEM DESIGN OF AN AUTOMATED LABORATORY AND ASSOCIATED ENTRY VEHICLE FOR UNMANNED MARTIAN EXPLORATION.**

C. E. Anderson (General Electric Co., Philadelphia, Pa.) and F. G. Beuf.

(International Astronautical Federation, International Astronautical Congress, 16th, Athens, Greece, Sept. 13-18, 1965, Paper.)

IN: SPACE CRAFT SYSTEMS; INTERNATIONAL ASTRONAUTICAL FEDERATION, INTERNATIONAL ASTRONAUTICAL CONGRESS, 16TH, ATHENS, GREECE, SEPTEMBER 13-18, 1965, PROCEEDINGS VOLUME 1.

Congress supported by the United Nations Educational, Scientific and Cultural Organization.

Edited by Michał Łunc.

Paris, Gauthier-Villars, Dunod; New York, Gordon and Breach; Warsaw, Państwowe Wydawnictwo Naukowe, 1966, p. 147-168.

Research sponsored by the General Electric Co.

A67-30932**JUPITER'S ATMOSPHERE - ITS STRUCTURE AND COMPOSITION.**

Jack A. Greenspan and Tobias Owen (IIT Research Institute, Astro Sciences Center, Chicago, Ill.).

Science, vol. 156, June 16, 1967, p. 1489-1494. 23 refs.

Study of the structure and composition of the atmosphere of Jupiter noting that recent laboratory and observational data support the hypothesis that the composition of Jupiter's atmosphere is consistent with the relative abundances of the elements found in the sun. A model based on this assumption provides a reasonable interpretation of abundances of hydrogen and other gases obtained from

studies of various regions of the planet's spectrum. Two presently unidentified absorptions may be caused by organic molecules in the Jovian atmosphere. P.v.T.

A67-31487 *

THE VOYAGER PROGRAMME.

Edgar M. Cortright (NASA, Washington, D.C.).
(American Astronautical Society, Goddard Memorial Symposium,
5th, Washington, D.C., Mar. 14, 15, 1967, Paper.)
Space Flight, vol. 9, July 1967, p. 222-227.
[For abstract see issue 12, page 2002, Accession no. A67-25232]

A67-32322

TWO-LAYER MODEL OF THE VENUSIAN ATMOSPHERE - INTER-
PRETATION OF RADAR OBSERVATIONS [DVUKHSLOINAIA
MODEL' ATMOSFERY VENERY - OB INTERPRETATSII RADIO-
LOKATSIONNYKH NABLIUDENII].
Iu. N. Vetukhnovskaia and A. D. Kuz'min (Akademiia Nauk SSSR,
Fizicheskii Institut, Moscow, USSR).
Astronomicheskii Vestnik, vol. 1, Apr.-June 1967, p. 85-88.
6 refs. In Russian.

Construction of a two-layer model of the Venusian atmosphere which satisfies the data of radioastronomic and radar self-radiation measurements, including the 3-cm wavelength. The upper, cold (300°K) absorbing layer defines the self-radiation spectrum, but has no influence on the results of radar observations, since absorption in this layer is very low even at the shortest (3.6 cm) wavelength of the radar measurements. The lower, hot absorbing layer, near the planet surface, absorbs radio emission at centimeter wavelengths and defines the spectrum of the effective cross section of the reflection of radar signals, but hardly affects the brightness temperature measurements, since the temperature of this layer differs only slightly from the surface temperature. The lower absorbing layer may be the lower level of clouds with a $(1 \text{ to } 2) \times 10^3 \text{ g/cm}^2$ dust content. V.P.

A67-32652 *

UPPER LIMITS ON LIQUID WATER IN THE VENUS ATMOSPHERE.
W. J. Welch and D. G. Rea (California, University, Space Sciences
Laboratory and Dept. of Astronomy, Radio Astronomy Laboratory
and Dept. of Electrical Engineering, Berkeley, Calif.).
Astrophysical Journal, vol. 148, June 1967, pt. 2, p. L151-L154.
12 refs.

NSF Grant No. GA-527; Contracts No. Nonr-222(54); No. NASr-220;
Grant No. NSG-101-61.

Discussion of a consequence of the recent discovery of HCl and HF in the atmosphere of Venus. The consequence is that, on account of the presence of HCl, there cannot be much liquid water in the Venusian atmosphere. HCl is highly soluble in water, and the resulting acid has a high dc conductivity. It is pointed out that if there were much of this acid in the Venusian atmosphere, the long-wavelength radar signals would be strongly attenuated, whereas the radar signals appear to reach the planet's surface with little attenuation. M.M.

A67-32826

MEASUREMENTS OF DISSOCIATIVE RECOMBINATION OF CO_2^+ IONS WITH ELECTRONS.

Charles S. Weller and Manfred A. Biondi (Pittsburgh, University,
Dept. of Physics, Pittsburgh, Pa.).
Physical Review Letters, vol. 19, July 10, 1967, p. 59-61. 10 refs.
Army-DASA-supported research.

Application of the microwave-afterglow differentially pumped quadrupole mass-spectrometer apparatus to a quantitative determination of the dissociative recombination coefficient $\alpha(\text{CO}_2^+)$ between electrons and CO_2^+ ions for models of the Martian ionosphere. The results suggest the need for modification of the Martian ionospheric models to conform to values of $\alpha(\text{CO}_2^+)$ substantially less than $10^{-6} \text{ cm}^3/\text{sec}$. M.F.

A67-33096

THE ASHEN LIGHT AND THE MAGNETIC FIELD OF VENUS.

A. J. Jeffries.
British Astronomical Association, Journal, vol. 77, June 1967,
p. 262, 263.

Discussion of the possibility of observing auroral phenomena on Venus, by making careful observations of the so-called "ashen light." The presence of auroras on Venus would imply the presence of a magnetic field, the existence of which has not as yet been ascertained, since the earth's auroral phenomena occur purely as a result of the earth's magnetic field. The ashen light of Venus appears as a faint glow illuminating the dark side of the planet. An aurora might be visible from earth as part of the ashen light, if it were sufficiently intense and well placed for observation. P.v.T.

A67-33187

RADIATIVE RELAXATION TIMES FOR MARS - A DISCUSSION OF MARTIAN ATMOSPHERIC DYNAMICS.

Richard Goody (Harvard University, Cambridge, Mass.) and
Michael J. S. Belton (Kitt Peak National Observatory, Tucson,
Ariz.).
Planetary and Space Science, vol. 15, Feb. 1967, p. 247-256.
17 refs.

NSF Grant No. G-24903.

Radiative relaxation times for temperature perturbations in CO_2 with small admixtures of water vapor under conditions which are similar to those occurring in the Martian atmosphere have been computed. Certain aspects of the influence of radiative transfer on dynamical phenomena in the Martian atmosphere are discussed in terms of these radiative relaxation times. It is found that: (1) diurnal changes in the temperature profile will extend to considerably greater heights in the Martian atmosphere than is the case on earth; the diurnal wave will propagate more by radiative transfer than by turbulent diffusion; (2) a nonnegligible diurnal wind system exists on Mars; (3) nonlinear interactions between the motion field and the initial state of radiative equilibrium are much smaller on Mars than on earth; and (4) radiative destabilization of regions with a negative lapse rate may be important in the upper Martian atmosphere. (Author)

A67-33196 *

ROTATIONAL EFFECTS ON THE DISTRIBUTION OF THERMAL PLASMA IN THE MAGNETOSPHERE OF JUPITER.

D. B. Melrose (Sussex, University, School of Mathematical and
Physical Sciences, Brighton, England; Yeshiva University, Belfer
Graduate School of Science, New York, N.Y.).
Planetary and Space Science, vol. 15, Feb. 1967, p. 381-393.
15 refs.

NASA-AEC-supported research.

The consequences of the assumption that the magnetosphere of Jupiter corotates with the planet are examined. It is found convenient to divide the magnetosphere into two regions. The inner region is qualitatively similar to the magnetosphere of the earth provided that the ratio of the scale height to the radius of Jupiter is much less than $1/12$. The outer region is dominated by rotational effects. It is expected to be slightly flattened, with a density falling off as Br^{-1} . The velocity distribution of the plasma becomes increasingly anisotropic with increasing distance. The corotating magnetosphere breaks up as a result of electrostatic microinstabilities at 7-8 radii, well inside the boundary with the solar wind. (Author)

A67-33232

VENUS - VOLCANIC ERUPTIONS MAY CAUSE ATMOSPHERIC OBSCURATION.

Gerald T. Davidson and Albert D. Anderson (Lockheed Aircraft Corp.,
Lockheed Missiles and Space Co., Research Laboratories, Palo
Alto, Calif.).
Science, vol. 156, June 30, 1967, p. 1729, 1730. 12 refs.

High rates of volcanic and tectonic activities are inferred from the high surface temperature of Venus. The effects of volcanic effluents, gas and dust, on obscuration in the atmosphere are considered. The optical extinction due to particulate matter is estimated from

A67-34095

assumed distributions as to particle size and altitude. As few as ten explosive eruptions per year would cause significant absorption and scattering of visible light. (Author)

A67-34095

THE RISE OF OXYGEN IN THE EARTH'S ATMOSPHERE WITH NOTES ON THE MARTIAN ATMOSPHERE.

L. V. Berkner and L. C. Marshall (Southwest Center for Advanced Studies, Dallas, Tex.).

(American Geophysical Union, Western National Meeting, 5th, General Assembly, Dallas, Tex., Sept. 1965, Paper.)

IN: ADVANCES IN GEOPHYSICS. VOLUME 12.

Edited by H. E. Landsberg and J. Van Mieghem.

New York, Academic Press, Inc., 1967, p. 309-331. 42 refs. NSF Grants No. 768; No. 4708; Contract No. Cwb-10531.

Discussion of oxygenic concentrations in the primitive atmosphere of the earth. The surface oxidation and photosynthetic oxygen production in a primitive terrestrial atmosphere are estimated from the present atmospheric level. Conjectures are made concerning the oxygenic levels in the Paleozoic and Silurian eras and in ensuing eras. Estimates of the composition of the Martian atmosphere and surface are made, and the possibility of life on Mars is considered. A general theory of the origin of planetary atmospheres is presented and discussed. M.F.

A67-34149

STUDY OF PHOTOGRAPHS OF MARS TAKEN BY MARINER 4 [CONSIDERATIONS SUR LES PHOTOGRAPHIES DE MARS PRISES PAR MARINER 4].

Glauco De Mottoni (Consiglio Nazionale delle Ricerche, Centro di Studio per l'Astrofisica, Osservatorio Astronomico, Merate, Italy).

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 186-194.

In French.

Analysis of enlargements of photographs of Mars transmitted by Mariner 4, which give a new interpretation of the visible brightness features. Cloud observations are discussed. A series of images obtained from a first graphic depiction involving the elimination of instrumental effects and a reduction of transmission traces is included. The pictures have been reproduced on a unified scale, with the outlined shape of each picture corresponding to the real contours of the regions viewed on the Martian surface. F. R. L.

A67-34151 *

RADIO OCCULTATION MEASUREMENT OF THE MARTIAN ATMOSPHERE OVER TWO REGIONS BY THE MARINER IV SPACE PROBE.

A. Kliore, D. L. Cain, and G. S. Levy (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

(COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper.)

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 226-239.

12 refs.

A67-34152 *

THE ATMOSPHERE OF MARS.

Francis S. Johnson (Southwest Center for Advanced Studies, Dallas, Tex.).

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 240-245.

9 refs.

Grant No. NSG-269.

Much new information has become available in recent years on the Martian atmosphere. Mariner 4 data have shown that the surface pressure is below 10 mb, a result that is not inconsistent with the most recent spectroscopic studies. If the Mariner 4 ionospheric data are interpreted in terms of an F2 peak, the atmosphere must be very cold at all levels and the exospheric temperature must be near 85°K. This result is in disagreement with studies of radiative equilibrium temperatures, which indicate a relatively warm exosphere, the temperature being in the vicinity of 400°K. As a consequence of this inconsistency and others of a similar nature, there is still a wide range of speculation concerning the properties of the Martian atmosphere. These inconsistencies will probably be resolved only after more detailed observations have been made in planetary probes, such as the distribution of resonance scattering of sunlight by atomic oxygen. (Author)

A67-34153

A STUDY OF THE GENERAL CIRCULATION OF THE MARTIAN ATMOSPHERE BASED UPON THE RESULT OF THE OCCULTATION EXPERIMENT FROM MARINER IV.

Wen Tang (Geophysics Corporation of America, GCA Technology Div., Bedford, Mass.).

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 246-252.

10 refs.

The model of the general circulation for the steady state and symmetrical regime based upon Charney's development is modified by including the lateral eddy viscosity. The surface stress is also adjusted slightly. The resulting modified model is used to study the mean zonal and meridional winds, and the type of circulation regime on Mars during the equinoctial seasons. With input parameters based on the recent occultation experiment from Mariner 4, the computed mean zonal wind at an isobaric surface of one quarter of the average surface pressure of Mars is about 36 m/sec. This compares to a value of about 33 m/sec computed for the earth's atmosphere with the same modified model. Comparing the calculated magnitude of the atmospheric pole-to-equator temperature difference at the middle level of the atmosphere with the observed temperature difference at the same level, as deduced from the observational indications of surface temperatures, it is concluded that the symmetrical regime cannot remain stable. Therefore, in the mean for the Martian year, a wave type circulation regime will prevail in the Martian atmosphere. (Author)

A67-34154

TRANSPARENCY OF THE MARTIAN ATMOSPHERE AND VISIBILITY OF SURFACE DETAILS IN BLUE AND ULTRAVIOLET LIGHT [TRANSPARENCE DE L'ATMOSPHERE MARTIENNE ET VISIBILITE DES DETAILS DE LA SURFACE DANS LE BLEU ET ULTRAVIOLET].

J. H. Focas (Centre National de la Recherche Scientifique, Service d'Aéronomie, Observatoire de Meudon, Meudon, Seine-et-Oise, France).

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 253-255.

In French and English.

The comparison of photographs taken simultaneously in red, green, blue, and UV light shows that the intensity of semitone areas of the soil of Mars tends to become equal to the intensity of the dark areas. This provokes a deformation of the usual configurations

of the planet. There are very tenuous veils observed, sometimes, in the blue and the UV. In such cases, they provoke a rapid fading of the semitone and dark areas, while the light areas maintain a higher relative intensity, giving the illusion of clouds. This does not exclude the existence of real clouds, which can easily be identified. Such cases are very rare. The visibility of the light and dark areas in the blue and the UV depends on the opacity of the veils. The formation and the opacity of the veils in the two hemispheres of the planet seem to follow a seasonal cycle. (Author)

A67-34156

SOME ASPECTS OF MARTIAN CLOUDS AND THEIR RELATIONSHIP TO THE TOPOGRAPHY.

R. A. Wells (London, University, Observatory, Mill Hill, Middx., England).

(COSPAR, International Space Science Symposium, 7th, Vienna, Austria, May 10-19, 1966, Paper.)

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS. Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 262-273.

12 refs.

Research supported by the European Space Research Organization.

A67-34158

A THEORETICAL INVESTIGATION OF CYTHEREAN, MARTIAN AND JOVIAN UPPER ATMOSPHERES.

Mikio Shimizu (Ochanomizu Women's University, Dept. of Physics, Tokyo, Japan).

IN: MOON AND PLANETS; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 7TH, VIENNA, AUSTRIA, MAY 10-18, 1966, PAPERS.

Symposium sponsored by the Committee on Space Research and the International Astronomical Union.

Edited by A. Dollfus.

Amsterdam, North-Holland Publishing Co., 1967, p. 296-298.

7 refs.

Theoretical investigation of the atomic and molecular processes in the upper atmospheres of Venus, Mars, and Jupiter, by using the atmospheric models recently proposed by the Jet Propulsion Laboratory group. The amounts of CO molecules in the Cytherean and Martian upper atmospheres produced by the photochemical reactions with the solar UV radiation may be about 2 and 0.2 cm STP, respectively. Then, the recombination of CO and O may cause the airglow of the intensities 20 kR and 45 R on Venus and Mars, respectively. The effect of diffusion should be taken into account to determine the distribution of O₂ molecules. The contribution of the solar corpuscular stream to the upper atmospheric phenomena may be appreciable, due to the lack of magnetism. On Jupiter, the molecular hydrogen is first ionized and then decomposed to produce the atomic hydrogen whose ionization may be responsible for the formation of a dense Jovian ionosphere (ρ_e , max $\sim 1.5 \times 10^7/\text{cm}^3$). The hydrogen atoms necessary for the CH₄ and NH₃ reactions in the lower atmosphere might be supplied by the downward diffusion from here. In order to study the diffusion problems, the solution of a set of relevant diffusion equations by a variational method has been proposed. (Author)

A67-34498 *

GROUND INSTRUMENTATION FOR MARINER IV OCCULTATION EXPERIMENT.

Gerald S. Levy (California Institute of Technology, Jet Propulsion Laboratory, Communication Research Section, Pasadena, Calif.), Tom Y. Otoshi (California Institute of Technology, Jet Propulsion Laboratory, Communications Elements Research Section, Pasadena, Calif.), and Boris L. Seidel (California Institute of Technology, Jet Propulsion Laboratory, Telecommunications Div., Pasadena, Calif.).

IEEE Transactions on Instrumentation and Measurement, vol. IM-16, June 1967, p. 100-114. 7 refs.

Description of the ground instrumentation system for the Mariner 4 occultation experiment whose objective was the determination of the Martian atmospheric parameters. The objective was accomplished by measuring the Doppler-frequency perturbations in the S-band telemetry link caused by the refractive index profile of the planetary atmosphere. It was necessary to measure extremely small deviations in frequency. The ground instrumentation requirements are described, and the equipment utilized is discussed, as well as the results obtained. The earth-based receiving stations employed standard phase-lock-loop receivers, and triple-conversion open-loop receivers. A high-power transmitter was used to transmit 100-kw signals to the spacecraft transponder, so that two-way Doppler could be obtained the instant the spacecraft emerged from occultation. Various simulation tests performed with the system are discussed.

T.M.

A67-34536 *

RAYLEIGH SCATTERING IN AN OPTICALLY THIN ATMOSPHERE AND ITS APPLICATION TO MARTIAN TOPOGRAPHY.

J. B. Pollack (Smithsonian Institution, Smithsonian Astrophysical Observatory; Harvard University, Harvard College Observatory, Cambridge, Mass.).

Icarus, vol. 7, July 1967, p. 42-46. 10 refs.

Grant No. NGR-09-015-023.

A relationship between surface pressure and atmospheric brightness is derived for an optically thin, Rayleigh scattering atmosphere. Under similar assumptions, the geometric albedo is expressed as a function of the optical depth of the atmosphere and arbitrary reflection properties of the surface. A recent determination of the atmospheric brightness from polarization measurements implies a surface pressure of about 20 mbar over the bright areas of Mars. Dust contamination is shown to be probably insufficient to reconcile this value of surface pressure with that obtained by the Mariner 4 occultation experiment. It is concluded that bright areas are lowlands and that elevation differences on the order of 10 km exist on Mars. (Author)

A67-34540 *

ON THE CHEMISTRY OF JUPITER'S UPPER ATMOSPHERE.

William C. Saslaw (California, University, Institute of Geophysics and Planetary Physics, Los Angeles; California Institute of Technology, Div. of Geological Sciences, Pasadena, Calif.; Princeton University, New Observatory, Princeton, N.J.) and Robert L. Willey (California Institute of Technology, Div. of Geological Sciences; Carnegie Institution of Washington and California Institute of Technology, Mount Wilson and Palomar Observatories, Pasadena, Calif.; U.S. Geological Survey, Astrogeology Branch, Flagstaff, Ariz.).

Icarus, vol. 7, July 1967, p. 85-93. 23 refs.

NASA-supported research.

Investigation into the ion-molecule chemistry of the upper Jovian atmosphere. Experimental results show that intense UV radiation reacts with the constituents of the Jovian atmosphere to produce C₂H₄, C₂H₆, C₃H₈, and higher polymers. The general procedure for calculating both equilibrium and nonequilibrium abundances of these products is formulated and applied to the case of the surface passage of a satellite shadow. A specific example is made of ethylene, for which an analytical approximation gives 10¹⁰ molecules in an atmospheric column of 1 cm² cross section after a very rapid rise to equilibrium. Such a concentration of ethylene does not substantially affect the infrared radiation in the shadow. (Author)

A67-34541

THE EFFECTIVE BRAKING HEIGHT FOR SMALL INTERPLANETARY PARTICLES IN THE MARTIAN UPPER ATMOSPHERE.

Uri Shafirir (Tel-Aviv University, Institute of Planetary and Space Science, Ramat Aviv, Israel).

Icarus, vol. 7, July 1967, p. 100-104. 7 refs.

Consideration of the dynamical interaction of small interplanetary particles with the Martian upper atmosphere. The equation of motion of a small particle, entering the Martian atmosphere

A67-34543

with cosmic velocity, is integrated numerically in a general form for three Martian model atmospheres. The results of the numerical integrations are compared with similar computations carried out for the earth's upper atmosphere. While in the case of the earth, the effective braking height (EBH) is around 90 km, the different Martian density profiles yield EBH of 105, 80, and 65 km for the models suggested by Chamberlain and McElroy, Donahue, and Johnson, respectively. A preliminary examination of the first photograph taken by Mariner 4 during its Martian flyby, which reveals the existence of light-scattering particles in the Martian upper atmosphere at altitudes of over 100 km, suggests that Chamberlain and McElroy's density profile is the most probable of the three. (Author)

A67-34543

VENUS - A CONTRIBUTION TO THE GREENHOUSE-IONOSPHERE DEBATE.

Reginald E. Newell (Massachusetts Institute of Technology, Dept. of Meteorology, Cambridge, Mass.).

Icarus, vol. 7, July 1967, p. 114-131. 106 refs.

The thesis that surface temperatures of 600-1000°K can be maintained by a greenhouse effect is questioned. Ionospheric models appear to have been rejected on the basis of a single measurement. It is suggested that ionospheric and microdischarge models be re-examined and that attempts to monitor the various physical phenomena on earth be made. In particular the possibility of a radio aurora on Venus that emits microwaves has not yet been eliminated by terrestrial measurements. If such a phenomenon were demonstrated then Venus could be undergoing an Ice Age if the albedo is close to 0.76 or could have temperatures similar to earth if the albedo is lower. (Author)

A67-34796

RADIOASTRONOMICAL RESEARCH ON VENUS AND MARS [RADIO-ASTRONOMISCHE UNTERSUCHUNGEN VON VENUS UND MARS].

Cornell H. Mayer (U.S. Navy, Office of Naval Research, Naval Research Laboratory, Washington, D.C.).

(Astronautics and Aeronautics, vol. 4, Apr. 1966, p. 13-25.)

Naturwissenschaftliche Rundschau, vol. 20, May 1967, p. 192-200. In German. (Translation).

Investigation of the atmosphere and surface of Venus and Mars by means of radio measurements, made chiefly with the aid of the large instruments located at Arecibo and Moscow. This method has proven to be especially useful in studying the planet Venus, whose surface is permanently hidden by a thick layer of clouds. It was found that, with Venus as well as with Mars, the main part of radio energy is reflected by smooth plain regions on the surface near the center of the disk. The manner in which reflecting power decreases toward the limb indicates that Venus has a smoother surface than the moon. The steepness of its slopes is, on the average, only half as great. The existence of dry minerals on Venus is indicated. The radioastronomical investigation of Mars did not give as good results as obtained with Venus, mainly due to the fact that Mars is farther away from the earth and smaller than Venus and most of the time is beyond the range of modern radiotelescopes. P.v.T.

A67-34933

RADIOPHYSICS OF JUPITER.

James W. Warwick (Colorado, University, Astro-Geophysics Dept., Boulder, Colo.).

Space Science Reviews, vol. 6, May 1967, p. 841-891. 166 refs.

Brief review of observational and theoretical developments regarding the nonthermal emission from Jupiter since 1963. Emphasis is placed on new data and their phenomenological interpretation. It is pointed out that the principal information still needed is more refined data, especially on the fast-time resolution polarimetry and spectroscopy of millisecond bursts, and that the polarization diversity on these bursts, as recorded at Arecibo, needs confirmation. M.M.

A67-35315

VEHICULAR DESIGN FOR A PLANETARY ATMOSPHERIC MEASUREMENT PROBE.

P. A. Giragosian and E. T. Myers (Raytheon Co., Space and Information Systems Div., Sudbury, Mass.).

American Astronautical Society and New England Academic Community, Regional Symposium on Planetary Geology and Geophysics, Boston, Mass., May 25-27, 1967, Paper. 13 p.

The problem of achieving a realistic design of a ballistic entry vehicle to measure the sensible atmospheric properties of the atmospheres of Mars and Venus, using present day state-of-the-art instrumentation, is treated. Vehicle design considerations including aerodynamic, thermodynamic, heat shield material selection, flight dynamics, structures and instrumentation considerations are discussed. The atmospheric properties to be measured are the density, pressure, temperature, scale height, and gas composition. Use is made of a small lightweight spherical ballistic entry probe to define the structure and composition of the atmospheres of Mars and Venus, from the dynamic response of the probe during the entry portion of flight. Onboard instrumentation, including pressure, and temperature sensors, spectrographs, and accelerometers are the sources of data. (Author)

A67-35442

APPLICATION OF THE HYPERSONIC ANALOG TO THE STANDING SHOCK OF MARS.

Murray Dryer and Gary R. Heckman (ESSA, Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.).

Solar Physics, vol. 2, July 1967, p. 112-124. 27 refs.

A magnetospheric boundary and its associated standing-shock wave for the earth are scaled down in size to apply to Mars. A suggestion by the Mariner 4 experimenters that their magnetometer may have detected a Martian shock at 0123 UT (earth) on July 15, 1965, is accepted. The scaling procedure used previously in the case of the Mariner 2 flyby of Venus on Dec. 14, 1962, as well as in the present case of Mars is repeated but with a different model. We propose a magnetospheric boundary for the earth, which is based on a maximum radius of 22 earth radii suggested by Imp-1 magnetometer data. We further suggest a low value (1.2) of the adiabatic exponent, γ . In addition we propose the use of the interplanetary magnetoacoustic Mach number, M_m^* , which is a combination of both Alfvén and ordinary gasdynamic Mach numbers. Our choice of values for these parameters is not unique since many such combinations exist which will show good agreement with observation. For example, the ratio of the Martian dipole moment to that for the earth is found to be 2.1×10^{-4} by our application of the hypersonic analog. This value compares very closely with 3×10^{-4} deduced as an upper bound by the Mariner 4 investigators. The synthesis is presented as an independent calculation based on the above theoretical considerations, together with the experimenters' probable observation of a Martian shock wave. (Author)

A67-35829

VOLTAGE BREAKDOWN OF MONOPOLE ANTENNAS IN THE ATMOSPHERES OF VENUS AND MARS.

J. A. Martin and J. B. Chown (Stanford Research Institute, Menlo Park, Calif.).

IEEE Transactions on Antennas and Propagation, vol. AP-15, July 1967, p. 589, 590. 11 refs.

Description of data representative of the breakdown of monopole antennas in simulated atmospheres of Venus and Mars. The data correspond to gas breakdown and to static conditions for antennas located on the planetary surfaces and on subsonic vehicles flying in the lower atmosphere of the planets. It is pointed out that bounds on the breakdown power level of antennas operating in currently postulated Martian and Venusian atmospheres can be predicted by measurement in air (upper bound) and in pure argon (lower bound). These bounds indicate that antenna systems on or near the surface of Mars may be limited in available radiated power because of low breakdown-power levels in the thin Martian atmosphere. M.M.

A67-36309**THE MEASUREMENT OF ABUNDANCES IN PLANETARY ATMOSPHERES USING AN IMAGE INTENSIFIER AND A SOLAR SPECTROGRAPH.**

J. E. Beckman (Oxford University, Observatory, Oxford, England). *Planetary and Space Science*, vol. 15, July 1967, p. 1211-1218. 16 refs.

Research supported by the Science Research Council.

An image intensifier tube has been used in conjunction with the solar installation at Oxford to obtain high resolution spectra of Venus and Jupiter. The spectra of Jupiter were used to obtain the equivalent width of the S(l) line of the quadrupole (4, 0) band of molecular hydrogen in the atmosphere of Jupiter. The result is 75 km-amagat of hydrogen above the reflecting layer. The spectra of Venus were used to set an upper limit to the abundance of oxygen in its atmosphere. The result is 1.75 m-amagat of oxygen above the reflecting layer.

(Author)

A67-37400**JUPITER'S GREAT RED SPOT AND THREE WHITE OVALS.**

Elmer J. Reese (New Mexico State University, Observatory, University Park, N. Mex.).

Sky and Telescope, vol. 34, Sept. 1967, p. 185, 186.

Observations of Jupiter's Great Red Spot and three white ovals, revealing a strong correlation between the rotational velocity of each of the three white ovals and its longitudinal distance from the Red Spot. An analysis of more than 6000 longitude determinations made between October 1955 and May 1967 indicates that during that interval the white ovals rotated more rapidly when near the Red Spot than when far away.

P.v.T.

A67-37479 ***THE PRESSURE AT THE CLOUD TOP AND THE ABUNDANCE OF HYDROGEN IN THE ATMOSPHERE OF JUPITER.**

J. E. Beckman (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

Astrophysical Journal, vol. 149, Aug. 1967, pt. 1, p. 453, 454. 10 refs.

Examination of abundance determinations in the Jovian atmosphere. Spectra which were recorded by the Struve 82-in. telescope, with a dispersion of 3.3 Å/mm, show clearly the narrow lines in the 6190 Å overtone band of methane. Methane line widths between half-intensity points were found to be 0.04 Å with a probable error of 15%. The average was used to set a value to the total atmospheric pressure of the mean reflecting layer for light of this wavelength, and to fix an upper limit to the hydrogen abundance above this layer.

R. B.S.

A67-37480**IMPROBABILITY OF NON-THERMAL RADIO EMISSION FROM VENUS WATER CLOUDS.**

F. D. Drake (Cornell University, Center for Radiophysics and Space Research, Ithaca, N.Y.).

Astrophysical Journal, vol. 149, Aug. 1967, pt. 1, p. 459-461. 16 refs.

Discussion of phenomenon discovered by Dickey (1951) and Sartor (1963) concerning centimeter-wavelength emission from charged and uncharged mercury droplets (but not water droplets) coming in contact with a surface or another droplet, establishing the possibility of nonthermal emission. Study of this phenomenon leads to the conclusion that electrical discharges involving droplets in plausible atmospheres cannot contribute a significant nonthermal microwave component, thereby indicating the improbability of nonthermal radio emission from water clouds on Venus.

R. B.S.

A67-38611**ULTRAVIOLET PHOTOGRAPHS AND THE RADAR CROSS SECTION OF VENUS IN 1966.**

C. Boyer (Toulouse, Université, Observatoire du Pic-du-Midi, Bagnères-de-Bigorre, Hautes-Pyrénées, France) and R. E. Newell (Massachusetts Institute of Technology, Dept. of Meteorology, Cambridge, Mass.).

Astronomical Journal, vol. 72, Aug. 1967, p. 679-681. 11 refs.

Account of an attempt to obtain UV photographs of Venus at the same time as 3.8-cm radar cross-section measurements. The UV photographs were taken with the Pic-du-Midi 108-cm reflector. The Cassegrain focal length of 15 m was extended to 40 m with the help of a simple diverging lens. There was no significant range difference in the simultaneous 3.8 and 23-cm data taken near inferior conjunction. The major logistic problem was with the radar system which was involved in several experiments during this period. One important point brought out by the Venus photographs made during the western elongation in 1966, is that the position of the features in the UV changes in an interval of a few hours. The radar observations taken so far have been limited to one measurement per day in order to obtain a reasonable SNR. The important point in the present context is the pertinence of the UV maps, which have been prepared from the photographs, to future radar experiments at short wavelength.

P.v.T.

A67-38933**PHYSICS OF PLANETS [FIZIKA PLANET].**

V. I. Moroz.

Moscow, Izdatel'stvo Nauka, 1967. 496 p. In Russian.

In this book an attempt is made to summarize all currently available information on the physical characteristics of the planets of the solar system, as determined by high-resolution spectroscopy, radio telescopes, radar and IR techniques, and photometry. Particular attention is given to the most essential problems of current interest: the Martian atmosphere, the surface temperature of Venus and the structure of the Venusian atmosphere, the nature of the radio emission from Jupiter, and the hypothetical Mercurian atmosphere. The problems discussed in regard to Mars include: the CO₂ content, total pressure, and chemical composition of the Martian atmosphere; cloudiness, winds, and surface temperature; the transparency and vertical structure of the atmosphere; the polar caps, continents, and dark regions. With respect to Venus, the problems examined include: the period of revolution, albedo, phase curve, and polarization of Venus; the CO₂ absorption bands and CO₂ dissociation; the chemical composition of the Venusian atmosphere and cloud cover; the temperature of Venus determined from radiation in the optical region of the spectrum and the radio emission and vertical atmospheric structure of Venus. Information on the giant planets includes: the various phenomena observed on the disk of Jupiter, a qualitative chemical analysis of the Jovian atmosphere, a quantitative interpretation of the spectra of Jupiter (chemical composition and pressure), the temperature of Jupiter and the chemical composition of its cloud cover, the vertical structure of the atmosphere above the cloud cover, the short-wave radio emission and the magnetic field of Jupiter, and the radio emission of Jupiter at decimeter wavelengths.

V.P.

A67-38999**TAYLOR COLUMNS.**

R. Hide (Massachusetts Institute of Technology, Dept. of Geology and Geophysics, Cambridge, Mass.) and A. Ibbetson (Woods Hole Oceanographic Institution, Woods Hole, Mass.).

IN: MAGNETISM AND THE COSMOS; NATO ADVANCED STUDY INSTITUTE ON PLANETARY AND STELLAR MAGNETISM, UNIVERSITY OF NEWCASTLE-UPON-TYNE, NEWCASTLE-UPON-TYNE, ENGLAND, APRIL 1965, PAPERS.

Edited by W. R. Hindmarsh, F. J. Lowes, P. H. Roberts, and S. K. Runcorn.

New York, American Elsevier Publishing Co., Inc., 1967, p. 343-347. 6 refs.

Research supported by the Royal Society of London and the Department of Scientific and Industrial Research; NSF Grant No. G-22390; Contracts No. AF 61(052)-216; No. Nonr-21966(00).

Investigation of the theoretical criterion for the occurrence of Taylor columns, involving the extension of qualitative work done by Taylor. In one experiment, a right circular cylinder is slowly moved with uniform speed along a diameter of a rotating cylindrical tank of liquid; in another, a flow is generated by a radial arm of circular cross section, which extends along a radius from the axis to the rim of the tank and which rotates at ($\omega_0 + \Omega$) rad/sec about the vertical axis of the tank. Typical flow patterns observed in these experiments are illustrated.

B.B.

A67-39000**EXPERIMENTS ON TAYLOR COLUMNS OVER HOLES.**

C. W. Titman (Newcastle-upon-Tyne, University, School of Physics, Dept. of Geophysics and Planetary Physics, Newcastle-upon-Tyne, England).

IN: MAGNETISM AND THE COSMOS; NATO ADVANCED STUDY INSTITUTE ON PLANETARY AND STELLAR MAGNETISM, UNIVERSITY OF NEWCASTLE-UPON-TYNE, NEWCASTLE-UPON-TYNE, ENGLAND, APRIL 1965, PAPERS.

Edited by W. R. Hindmarsh, F. J. Lowes, P. H. Roberts, and S. K. Runcorn.

New York, American Elsevier Publishing Co., Inc., 1967, p. 348-351. 6 refs.

Derivation of the conditions under which lengthy studies of Taylor columns over both hills and hemispheric holes can be performed. Right circular cylindrical obstacles about one-eighth the depth of fluid in a tank are placed diametrically opposite one another; one forming a hill, the other a hole. Dye is injected midway between the base and the lid of the tank at points above the hill and the hole, and at other positions. In the case of the cylindrical obstacles the Taylor columns appear to form cylinders circumscribing the obstacles, while the Taylor column above the hole is of a smaller radius than the hole itself.

B. B.

A67-39001**MODELS OF JUPITER AND SATURN.**

Wendell C. DeMarcus (Kentucky, University, Lexington, Ky.).

IN: MAGNETISM AND THE COSMOS; NATO ADVANCED STUDY INSTITUTE ON PLANETARY AND STELLAR MAGNETISM, UNIVERSITY OF NEWCASTLE-UPON-TYNE, NEWCASTLE-UPON-TYNE, ENGLAND, APRIL 1965, PAPERS.

Edited by W. R. Hindmarsh, F. J. Lowes, P. H. Roberts, and S. K. Runcorn.

New York, American Elsevier Publishing Co., Inc., 1967, p. 352-364. 23 refs.

Discussion of observational material bearing on Jupiter and Saturn. An attempt is made to see how large a reduction of manifold size is achieved by the addition of each observational piece of evidence. It is pointed out that the gross structure of Jupiter and Saturn and also their hydrogen abundances seem fairly well determined by those data which are easiest to interpret - namely, mass, volume, and the external potential coefficient. However, precise models of the density and composition distributions would not seem to be attainable at the present time. The best provisional models are undoubtedly those of Peebles. Trustworthy model atmospheres are not available at present.

M.M.

A67-39092**JUPITER - A WORTHY GOAL FOR SPACE RESEARCH AND ASTRO-NAUTICS [JUPITER - EIN LOHNENDES ZIEL DER WELT-RAUMFORSCHUNG UND RAUMFLUGTECHNIK].**

Wolfgang Kokott (Bölkow GmbH, Ottobrunn, West Germany).

DGRG, Mitteilungen, vol. 20, Aug. 1967, p. 3-6. 8 refs. In German.

Review of the present state of knowledge regarding the planet Jupiter, as a basis of further research. While interplanetary investigations in the U.S. and USSR are mainly concentrated on Mars and Venus, research on the planet Jupiter is recommended for German and other continental European scientists. With an equatorial diameter of 142,700 km, Jupiter is the largest planet of the solar system. Its white bands and Great Red Spot are well known features. The atmosphere of Jupiter is believed to contain great quantities of hydrogen and helium, and its interior probably also contains these elements. Jupiter is the only planet other than the earth known to have a magnetic field and a radiation belt. Jupiter has 12 satellites: 5 inner moons, 3 central moons, and 4 outer moons (the latter believed to be asteroids captured by the gravitational field of Jupiter). Many questions remain unresolved, among them the interior structure of Jupiter, the nature of the Great Red Spot, and the cosmogony of the planet and its satellites.

P.v.T.

A67-39299 #

THE ATMOSPHERIC ACTIVITY OF JUPITER IN 1964-1965 ACCORDING TO DATA OF PHOTOMETRIC OBSERVATIONS [ATMOSFERNAIA AKTIVNOST' IUPITERA V 1964-1965 gg. PO DANNYM FOTOMETRICHESKIKH NABLIUDENII].

A. N. Aksenov, Z. N. Grigor'eva, N. V. Priboeva, Z. G. Romanenko, and V. G. Teifel' (Akademiia Nauk Kazakhskoi SSR, Astronomicheskii Institut, Kazakh SSR).

Astronomicheskii Vestnik, vol. 1, July-Sept. 1967, p. 173-179. 5 refs. In Russian.

Values of the photometric activity factor are determined from photographs of Jupiter at different wavelengths obtained for 75 observational nights during the period of the planet's apparition in 1964-1965. A cyclic change in activity having a period of about 3 months was discovered. The periodicity is best observed in the long-wave region of the spectrum. The northern hemisphere of Jupiter played the principal role in the observed changes. In the southern hemisphere the amplitude of changes in activity was considerably smaller, and there was no evident periodicity. In the second half of the period, the activity fluctuations were damped but the mean value remained almost the same as in the first half.

(Author)

A67-39556 ***LIFE IN THE CLOUDS OF VENUS?**

Harold Morowitz (Yale University, Dept. of Molecular Biophysics, New Haven, Conn.) and Carl Sagan (Harvard University, Harvard College Observatory; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).

Nature, vol. 215, Sept. 16, 1967, p. 1259, 1260. 14 refs. NASA-supported research.

Speculation on an indigenous biology in the clouds of Venus involving the stirring up of minerals from the planet's surface. A postulated photosynthetic organism could reside just below the Venus clouds, or in the lower cloud deck. Water would be collected either as rain or by contact with the droplets, and minerals blown up from the surface could be captured on the sticky underside of the organism, and ingested by pinocytosis.

B. B.

A67-40094 ****A RADIO OCCULTATION EXPERIMENT TO PROBE THE ATMOSPHERE OF VENUS.**

Arvydas Kliore, Dennis A. Tito, Dan L. Cain (California Institute of Technology, Jet Propulsion Laboratory, Systems Analysis Research Section, Pasadena, Calif.), and Gerald S. Levy (California Institute of Technology, Jet Propulsion Laboratory, Communications Elements Research Section, Pasadena, Calif.).

(American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 5th, New York, N.Y., Jan. 23-26, 1967, Paper 67-118.)

Journal of Spacecraft and Rockets, vol. 4, Oct. 1967, p. 1339-1346. 30 refs.

[For abstract see issue 06, page 1085, Accession no. A67-18310]

A67-40120 #**ON VENUS RADIATION SPECTRUM IN MILLIMETER RANGE [O MILLIMETROVOM SPEKTR E IZLUCHENIIA VENERY].**

A. P. Naumov and M. B. Kanevskii (Gor'kovskii Gosudarstvennyi Universitet, Nauchno-Issledovatel'skii Radiofizicheskii Institut, Gorki, USSR).

(Vsesoiuznaia Konferentsiia po Radioastronomii, 5th, Kharkov, Ukrainian SSR, Oct. 18-22, 1965.)

Radiofizika, vol. 10, no. 8, 1967, p. 1058-1069. 31 refs. In Russian.

For a number of models of the Venus atmosphere, the brightness temperature has been calculated in $\nu = 48-72$ Gc range in which the presence of a thin structure of the planet radiation spectrum caused by molecular oxygen may be expected. In some cases the brightness temperature is found to fall at the resonance frequencies by $\approx 20-90^\circ\text{K}$, due to oxygen presence. It is noted that the experimental information of the physical conditions on the planet may be obtained in the spectral region $\nu \approx 48-72$ Gc.

(Author)

A67-40140 ***THE ATMOSPHERE OF MARS - A DERIVATION OF ENGINEERING AND DESIGN PARAMETERS.**

George S. West, Jr. and W. T. Roberts (NASA, Marshall Space Flight Center, Aero-Astrodynamic Laboratory, Aerospace Environment Div., Space Environment Branch, Huntsville, Ala.).

IN: AMERICAN ASTRONAUTICAL SOCIETY, SOUTHEASTERN SYMPOSIUM ON MISSILES AND AEROSPACE VEHICLES SCIENCES, HUNTSVILLE, ALA., DECEMBER 5-7, 1966, PROCEEDINGS. VOLUME 2.

Symposium sponsored by the American Astronautical Society, the University of Alabama, NASA Marshall Space Flight Center, and the Missile Command of the U.S. Army. Huntsville, Ala., American Astronautical Society, Southeast Section, 1966, p. 58-1 to 58-11. 11 refs.

Study of the atmosphere of Mars, taking into account the gravitational and magnetic fields, and their interaction with the atmosphere of the planet. Since the upper atmosphere of a planet is subject to diurnal, latitudinal and solar cyclic variations, three atmospheric models (high, mean, and low density) were generated with the suggestion that the mean density model be used for design, and that the design should be critically tested to verify its survival in either of the other atmospheric models. It is not expected that orbiters of the planet Mars will encounter excessive drag for the lower-density model, since the atmospheric density at 100 km on Mars is about the same as that at 300 km on earth. Above this altitude, the atmospheric density for Mars falls off at a much faster rate than it does on earth. This is due to the relatively low temperatures between 100 and 200 km. This atmosphere is found to stabilize by about 1000 km because of the high temperatures encountered.

P.v.T.

A67-40141 ***ENVIRONMENT OF JUPITER.**

Carroll L. Hasseltine (NASA, Marshall Space Flight Center, Aero-Astrodynamic Laboratory, Aerospace Environment Div., Space Environment Branch, Huntsville, Ala.).

IN: AMERICAN ASTRONAUTICAL SOCIETY, SOUTHEASTERN SYMPOSIUM ON MISSILES AND AEROSPACE VEHICLES SCIENCES, HUNTSVILLE, ALA., DECEMBER 5-7, 1966, PROCEEDINGS. VOLUME 2.

Symposium sponsored by the American Astronautical Society, the University of Alabama, NASA Marshall Space Flight Center, and the Missile Command of the U.S. Army. Huntsville, Ala., American Astronautical Society, Southeast Section, 1966, p. 59-1 to 59-9.

Study of the planet Jupiter, its atmosphere, and its atmospheric temperatures. Jupiter's huge mass gives the planet an acceleration due to gravity at the poles of more than two and one half times that of the earth. Its rotation period of about 9 hr 55 min is the smallest of all the planets and creates phenomena unique to Jupiter. The planet's high rotation rate causes the shape of the planet to deviate from a true sphere: a distinct flattening of the poles is visible. Light and dark bands of clouds (zones and belts) run parallel to the equator. It has been confirmed that hydrogen and helium are the dominant gases of the Jovian atmosphere. Thornton and Welch (1963) estimated the temperature of the Jovian cloud tops to be $144 \pm 23^\circ\text{K}$ based on their measurement made at 8.35 mm wavelength. Temperatures are believed to increase with depth below the ammonia cloud tops.

P.v.T.

A67-40177**AEROTHERMODYNAMIC CONSIDERATIONS FOR A PLANETARY ENTRY PROBE.**

P. A. Giragosian and E. T. Myers (Raytheon Co., Space and Information Systems Div., Sudbury, Mass.).

IN: AMERICAN ASTRONAUTICAL SOCIETY, SOUTHEASTERN SYMPOSIUM ON MISSILES AND AEROSPACE VEHICLES SCIENCES, HUNTSVILLE, ALA., DECEMBER 5-7, 1966, PROCEEDINGS. VOLUME 2.

Symposium sponsored by the American Astronautical Society, the University of Alabama, NASA Marshall Space Flight Center, and the Missile Command of the U.S. Army. Huntsville, Ala., American Astronautical Society, Southeast Section, 1966, p. 96-1 to 96-12. 45 refs.

Discussion of the aerodynamic characteristics of a small, lightweight probe in the form of a spherical entry vehicle which, from the dynamic response of the probe during entry, defines the structure and composition of a planetary atmosphere. The following factors were considered and led to the conclusion that a spherical shape was the optimum shape for the probe: (1) drag factors, (2) static stability, (3) dynamic stability, (4) entry trajectory, (5) pressure distribution over a sphere, (6) shock-standoff distance and shape, (7) gasdynamic effects on vehicle stability, (8) flowfield properties, and (9) effect of residual and induced spin rate.

R.B.S.

A67-40799 ***MARTIAN IONOSPHERE - A COMPONENT DUE TO SOLAR PROTONS.**

Carl Sagan and Joseph Veverka (Harvard University; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).

Science, vol. 158, Oct. 6, 1967, p. 110-112. 22 refs.

Grant No. NGR-09-015-023.

Contention that some component of the observed Martian atmosphere, perhaps the subsidiary maximum at an altitude of 95 km, is due to penetration of protons from the solar wind into the Martian atmosphere. The proton ionization should be more nearly isotropic and much more time-variable than the electromagnetic contribution. Therefore, observations at a range of local times during a Martian day, and over a period including several solar events, seem indicated. Such observations cannot readily be performed by a flyby vehicle, but represent a natural radio-occultation experiment for a small Mars orbiter. The low surface magnetic-field strength of Venus suggests that solar protons may also be producing ionization in the atmosphere of that planet. Forthcoming radio-occultation experiments near Venus by flyby and projected orbiter vehicles will be useful in examining this possibility.

P.v.T.

A67-40999 ***LIFE DETECTION BY ATMOSPHERIC ANALYSIS.**

Dian R. Hitchcock (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.) and James E. Lovelock (California Institute of Technology, Jet Propulsion Laboratory, Bio-Science Section, Pasadena, Calif.).

Icarus, vol. 7, Sept. 1967, p. 149-159. 16 refs.

Contract No. NASw-871.

Living systems maintain themselves in a state of relatively low entropy at the expense of their nonliving environments. We may assume that this general property is common to all life in the solar system. On this assumption, evidence of a large chemical free energy gradient between surface matter and the atmosphere in contact with it is evidence of life. Furthermore, any planetary biota which interacts with its atmosphere will drive that atmosphere to a state of disequilibrium which, if recognized, would also constitute direct evidence of life, provided the extent of the disequilibrium is significantly greater than abiological processes would permit. It is shown that the existence of life on the earth can be inferred from knowledge of the major and trace components of the atmosphere, even in the absence of any knowledge of the nature or extent of the dominant life forms. Knowledge of the composition of the Martian atmosphere may similarly reveal the presence of life there. (Author)

A67-41836 ***AN UPPER LIMIT FOR ATMOSPHERIC CARBON DIOXIDE ON MERCURY.**

Jay T. Bergstralh, Harlan J. Smith (Texas, University, Dept. of Astronomy, McDonald Astronomical Observatory, Fort Davis, Tex.), and Louise D. Gray (Texas, University, Dept. of Astronomy, McDonald Astronomical Observatory, Fort Davis, Tex.; California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

Astrophysical Journal, vol. 149, Sept. 1967, pt. 2, p. L137-L139. 7 refs.

Determination of the upper limit of CO_2 in the atmosphere of Mercury. It is reduced sharply due to the strength of the 12,000-Å CO_2 bands which now can be reached at high dispersion. An upper

A67-42325

limit of 0.58 m-atm is assigned to the abundance of CO₂ on Mercury during the observations, which implies an upper limit during March and April 1967 of about 0.04 mb to the surface partial pressure of CO₂. B. B.

A67-42325 *

PLANETARY ATMOSPHERES AND THE ORIGIN OF THE MOON.
A. G. W. Cameron (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N. Y.).

IN: THE EARTH-MOON SYSTEM; PROCEEDINGS OF AN INTERNATIONAL CONFERENCE, NASA GODDARD INSTITUTE FOR SPACE STUDIES, NEW YORK, N. Y., JANUARY 20, 21, 1964. Conference sponsored by the NASA Goddard Institute for Space Studies.

Edited by B. G. Marsden and A. G. W. Cameron.
New York, Plenum Press, Division of Plenum Publishing Corp., 1966, p. 234-273. 32 refs.

Discussion of the origin of the earth-moon system. Following a hypothetical description and analysis of the atmosphere of Venus (somewhat anachronistic at this point) and a theory concerning the origin of the earth's atmosphere, it is hypothesized that the moon was formed from terrestrial material ejected from the earth during a process of rotational instability. For the purpose of the hypothesis it is assumed that the rotational instability would be triggered by the formation of the iron core in an elongated Jacobi ellipsoid. Objections are presented to this hypothesis and to other theories concerning the atmosphere of the earth and Venus, as stated by MacDonald (1964). R. B. S.

A67-42399 *

THE EVOLUTION OF THE MARINER SPACECRAFT.

J. James (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

International Astronautical Federation, International Astronautical Congress, 18th, Belgrade, Yugoslavia, Sept. 24-30, 1967, Paper, 15 p.

Discussion of the Mariner series of space vehicles. The evolution of the Mariner designs is outlined, and the conversion of the Mariner Mars vehicle of 1964 to the Venus spacecraft of 1967 is described. It is concluded that the most significant contribution of the Mariner-series vehicles to future space flights has been the atmospheric density measurements made by Mariner 4 as it occulted Mars; data derived from this event have radically changed the design of future entry missions, especially those involving the survival of large instrument packages on the Martian surface. B. B.

A67-42963 *

CURRENT AND FUTURE PROBLEMS IN EARTH AND PLANETARY ATMOSPHERE ENTRY.

Alvin Seiff (NASA, Ames Research Center, Vehicle Environment Div., Moffett Field, Calif.).

American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 4th, Anaheim, Calif., Oct. 23-27, 1967, Paper 67-803. 11 p. 19 refs.

Members, \$1.00; nonmembers, \$1.50.

Five problems are selected for review to indicate the present status of atmosphere entry technology. The problems selected are (1) high speed and low Reynolds number effects on aerodynamics of blunt, lifting entry vehicles; (2) radiative heating of blunt bodies used as planetary return vehicles; (3) problems of ablation heat shields in severe heating environments; (4) effects of ablation on dynamics of slender entry vehicles; and (5) transonic dynamic stability of large-angled conical bodies. This selection represents the subject areas - aerodynamic forces, static and dynamic stability, heating, heat protection, and a phenomenon in which several of these areas interact. The effects of ablation on slender vehicle dynamics, the behavior of heat shields in severe environments, and the intense radiative exposure of blunt vehicles at manned planetary return velocities are the only problems that seem to present fundamental difficulties for future vehicles. (Author)

1966

AEROSPACE MEDICINE AND BIOLOGY ABSTRACTS

A66-81145

THE GREENHOUSE EFFECT IN A GRAY PLANETARY ATMOSPHERE.
Rupert Wildt (Yale U. Obs., New Haven, Conn.; and Goddard Inst. for Space Studies, New York, N. Y.)

Icarus, vol. 5, Jan. 1966, p. 24-33. 6 refs.

Hopf's analytical solution is illustrated for several values of the greenhouse parameter, i.e., the ratio of gray absorption coefficients for insulating and escaping radiation, assumed to be constant at all depths. As the familiar planetary atmospheres are nongray in the extreme, this model of the greenhouse effect does not contribute much to understanding their temperature regime; but, to date, it is the only problem in planetary radiative equilibrium which has been solved rigorously.

A66-81966

ON THE ABUNDANCE OF EARTH-LIKE PLANETS.

F. J. Donahoe (Wilkes Coll., Wilkes-Barre, Pa.)

Icarus, vol. 5, May 1966, p. 303-304. 5 refs

Earth-like planets may be more of a rarity than they were thought to be. The only other planet of the solar system which is large enough to retain for eons gases other than hydrogen and helium is Venus. It is hypothesized that the Earth's early encounter with the Moon dispersed the gases of the proto-Earth's atmosphere. Planets of approximately Earth mass should be Venus-like rather than Earth-like unless they form part of a double planet.

A66-81851

EFFECTS OF ULTRA-VIOLET ALONE AND SIMULATED SOLAR ULTRA-VIOLET RADIATION ON THE LEAVES OF HIGHER PLANTS.

Morris G. Cline (Calif. Inst. of Technol., Div. of Biol., Pasadena) and Frank B. Salisbury (Utah State U., Plant Sci. Dept., Logan).

Nature, vol. 211, Jul. 30, 1966, p. 484-486. 12 refs.

NASA supported research.

Leaf-survival experiments involving 67 species with special emphasis on *Xanthium pennsylvanicum*, *Zea mays*, and *Pinus nigra* were conducted after ultra-violet light alone and after high-intensity simulated solar spectrum. In the first experiment, there was a wide variation in the resistance of the species tested. In the second experiment, the total radiation levels were equivalent to those above the atmosphere of Mars, Earth, and Venus (0.86, 2.00, and 3.82 cal./cm.²/min., respectively). *Xanthium* leaves were killed after 1.8 hr. of Venusian-level radiation but leaf-kill by Martian-level radiation required 4.5 hr. Destruction of exposed leaf blades of week-old *Zea* plants required 8 hr. of Venusian-level radiation and 32 hr. of Martian-level radiation. *Pinus* seedlings showed no serious damage until nearly 100 hr. of Venusian-level radiation and 400 hr. (30 days) of terrestrial-level radiation.

1967

AEROSPACE MEDICINE AND BIOLOGY ABSTRACTS

A67-80329

MARTIAN ATMOSPHERE AND CRUST.

S. Miyamoto (Kyoto U., Kwasan Obs., Japan).

Icarus, vol. 5, Jul. 1966, p. 360-374. 29 refs. N. Y. Acad. of Sci., Ore. U., and Dr. James Q. Gant supported research.

The Martian atmosphere in its average condition is inactive and transparent to long-wave radiation. It is activated when moisture is supplied by the evaporation of the polar cap in spring time. As typical examples, the great yellow cloud in 1956, the Neith-Casius cloud, and the Propontis cloud are described. It is shown that we can derive some knowledge about surface relief indirectly from cloud observations. In the Martian summer, energy flows from the summer hemisphere to the winter hemisphere and the prevailing wind over middle latitudes turns from spring westerlies to summer easterlies. This prediction has been confirmed through the following observations: a springtime polar front and associated dark fringe, some peculiar behavior of the polar cap shrinking, and the summertime diagonal cloud layers. A tentative picture of the circulation pattern in the northern hemisphere is proposed on the basis of our cloud data. Crater morphology revealed by the Mariner IV photographs suggests that craters are one of the characteristic features of the original crust of terrestrial-type planets and that Martian deserts and maria correspond to the terra and maria of the Moon and the continents and oceans of our Earth, respectively. Canals are interpreted as tectonic lines. It may be shown how wind erosion destroys most of the tectonic lines but develops some of them into canals when they are properly located along the courses of vapor migration.

A67-80916

VENUS: ATMOSPHERIC EVOLUTION.

Margaret O. Dayhoff, Richard V. Eck (Natl. Biomed. Res. Found., Silver Spring, Md.), Ellis R. Lippincott (Md. U., Dept. of Chem., College Park), and Carl Sagan (Harvard U. and Smithsonian Astrophys. Obs., Cambridge, Mass.).

Science, vol. 155, Feb. 3, 1967, p. 556-558. 22 refs.

NASA Contract 21-003-002, NASA Grants 21-002-059 and NGR 09-015-023.

Because of the high temperatures prevailing in the lower atmosphere of Venus, its chemistry is dominated by the tendency toward thermodynamic equilibrium. From the atomic composition deduced spectroscopically, the thermodynamic equilibrium composition of the atmosphere of Venus is computed, and the following conclusions drawn. (1) There can be no free carbon, hydrocarbons, formaldehyde, or any other organic molecule present in more than trace amounts. (2) The original atomic composition of the atmosphere must have included much larger quantities of hydrogen and a carbon/oxygen ratio ≤ 0.5 . (This ratio is now almost precisely 0.5.) (3) The present atomic proportions of the atmosphere of Venus are so unique that an evolutionary mechanism involving two independent processes seems necessary, as follows. Water,

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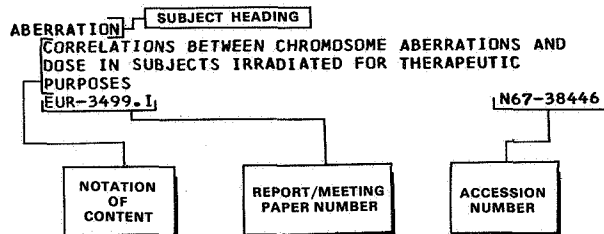
originally present in large quantities, has been photodissociated in the upper atmosphere, and the resulting atomic hydrogen has been lost in space. The resulting excess oxygen has been very effectively bound to the surface materials. (4) There must be some weathering process, for example, violent wind erosion, to disturb and expose a sufficient quantity of reduced surface material to react with the oxygen produced by photodissociation.

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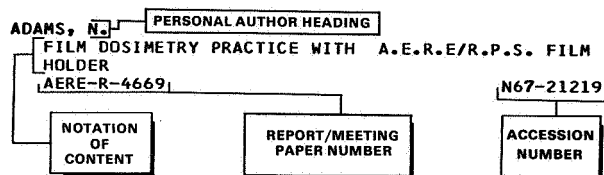
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